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INSTRUCTION MANUAL

FOR

SPECTRUM ANALYZER

MODEL ESA-1000

ELECTRO-METRICS
A PENRIL COMPANY

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SECTION I

Introduction and Specifications

1.1 THE MANUAL

This manual contains all relevant information for the operation, maintenance, and repair of the ESA-1000 Spectrum Analyzer.

1.2 THE ESA-1000

The ESA-1000 Spectrum Analyzer has been designed to measure electromagnetic interference (EMI) over the frequency range of 100 kHz to 1000 MHz, while retaining the ability to perform the usual spectrum analyzer applications of spectrum and waveform analysis. By incorporating CISPR IF bandwidth and Quasi-Peak detection circuits into the instrument, the electrical characteristics thus conform to the specifications and requirements set forth in various CISPR (Comite International Special des Perturbations Radio electriques) and related VDE (Verband Deutschen Elektrotechniker)-FCC mandates. The ESA-1000 can therefore be used to determine compliance to EMI conducted limits for the frequency range 100 kHz to 30 MHz and to EMI Radiated limits for the frequency range 30 MHz to 1000 MHz.

The ESA-1000 has the capability to read Electric Field strength directly since the digital indication for the reference level includes the antenna factor offset for the antenna type being utilized. The CRT Display has a full 80 dB Log range with an LED digital display indicating the center frequency the instrument is tuned to. The ESA-1000 has the capability to drive an optional X-Y recorder which produces a hard copy record of the information on the CRT Display.

A useful option for the ESA-1000 is the DM-1000 Digital Memory unit. This optional module permits a visual display on the CRT of data being acquired at the slow scan rates dictated by the CISPR Quasi-Peak time constants. The memory unit stores the data being acquired, at the slow scan rate, and then displays it on the CRT at a faster sweep rate for improved visual interpretation.

1.3 UNPACKING

1.3.1 Remove the instrument carefully from the shipping carton and examine thoroughly for shipping damage. If there is any damage, replace the instrument in the shipping carton and immediately inform the manufacturer and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

1.3.2 Check contents of the carton against the shipping slip to be sure that all components and accessory items ordered are present. Notify the manufacturer immediately of any missing items.

1.4 ELECTRONIC SHIPPING DAMAGE

Before leaving the factory, this instrument was subjected to a complete operational check. However, it is possible that electronic damage may have occurred in transit. It is desirable, therefore, to check the operation of the instrument as soon as possible after unpacking.

To do so, perform the calibration tests outlined in Section IV. If the instrument does not perform as per these instructions, inform the Electro-Metrics Customer Service Department (518) 843-2600, giving the information required in paragraph 1.3.1.

1.5 ELECTRICAL SPECIFICATIONS

The electrical and general specifications for the ESA-1000 Spectrum Analyzer are given in Table 1.1.

ESA-1000 SPECIFICATIONS

Frequency Specifications

Frequency Range: 100kHz to 1000MHz

Center Frequency Display: Unit of 1MHz, digital display by LED.

Center Frequency Display Accuracy: Within ± 10MHz.

Scan Width: By DISPERSION/DIV switch, 100MHz/Div to 100kHz/Div in 1-2-5 steps and zero scan.

Scan Linearity: Within ±5%

Tuning Mode: By Center Frequency Tuning.

Frequency Stability: Within 200kHz/5 minutes

Residual FM: Within 10kHz p-p

Noise Sidebands: -70dBc, 200kHz away from carrier with IF B.W. 10kHz.

IF Bandwidth: 300kHz, 100kHz, 30kHz, 10kHz (3dB) automatically set by Dispersion/Div. switching or 1.5MHz, 120kHz, 9kHz (6dB) manually set.

IF Bandwidth Accuracy: Within ±20%

IF Bandwidth Selectivity: 60dB/3dB IF Bandwidth ratio < 15:1

IF Bandwidth Switching Accuracy: Within ±1dB.

Amplitude Specifications

Display on CRT: Switchable to 10dB/div., 5dB/div., or LINEAR

LOG Display Accuracy: Within ± 1dB/10dB, ±1.5dB/40dB, ±2dB/80dB

Reference Level Display: 3 digits, 7-segment LED, 1dB resolution.

Reference Level Selection: Input Level (dBuV), Field Strength (dBuV/m) "A" or "B", Field Strength measurement "A" is half-wave dipole, "B" is Log periodic antenna. Respective antenna factor included in Reference Level.

Reference Level Accuracy: Within ±1.5dB.

Dynamic Range on CRT: 80dB

Average Noise Level: Below 5dBuV (at IF Bandwidth 10kHz, Video Filter 100Hz)

Spurious Response: -70dB or less (at RF ATT. 0dB, 80dBuV input)

Residual Response: Less than 20dBuV (at RF ATT. 0dB, 80dBuV input)

Video Filter: 100Hz, 10kHz, OFF switchable in MEAN Detection Mode.

Frequency Response: Within ±1dB, 100kHz to 1000MHz

IF Gain: 0 to 30dB in 10dB steps, -6dB to +6dB in 1dB steps

Gain Compression: Less than 1dB (at RF ATT. 0dB, 100dBv input)

Detection Method: Mean (Average Value) Dynamic Range 80dB and CISPR Quasi-Peak Dynamic Range 40dB.

Input Specifications

Input Connector: Type N.

Input Impedance: 50 ohms.

V.S.W.R.: Below 1.5 at RF ATT. 10dB.

Input Attenuator: 0 to 40dB in 10dB steps

Max. Permissible Input Level: 130dBuV ±50V DC

Scan Specifications

Scan Time: 20ms. to 10s continuously variable

Scan Mode: Single, Manual, Auto.

General Specifications

CRT: 94 x 75mm (scale 10 x 8) P31 phosphor

X Axis Output: Approximately ±5v, Impedance 10K ohms

Y Axis Output: Approximately 0 to 3.5V, Impedance 10K ohms

Audio Monitor Output: 8 ohms (Earphone EHF-25)

Calibration Output: Frequency: 100MHz ±200kHz
Level: 80dBuV ±0.5dB

Operational Temperature: 0°C to +40°C

Power Requirements: 115VAC ±10% 50/60Hz, consumption less than 50VA (at least 3.5 hours with BAT-1000 Battery Pack)

External Dimensions: Approximately 12" (W) x 7" (H) x 15" (D) [300 x 170 x 430mm]

Weight: Approximately 27 pounds.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

TABLE 1.1 ESA-1000 Specifications

SECTION II
Theory of Operation

2.1 GENERAL

The following section briefly describes the major circuitry of the ESA-1000 Spectrum Analyzer. The discussion follows, as close as possible, the signal flow through the analyzer starting with the RF INPUT section. Use of the block diagrams and schematics located throughout this section and the schematics located in Section VII will be helpful in understanding the function and operation of the circuitry.

2.2 SYNOPSIS OF UNIT OPERATION

The ESA-1000 Spectrum Analyzer is a heterodyne receiver which initially upconverts the input signal (100 kHz to 1000 MHz) to 1153.3 MHz at the 1st MIXER stage for improved image signal rejection. The LO oscillator for the 1st MIXER stage comprises a YIG tuned oscillator which covers the frequency range of 1000 MHz to 2200 MHz. The 1153.3 MHz IF signal is then downconverted twice to obtain the final IF frequency of 3.3 MHz. This final IF frequency is next applied to the input of the IF Filter section.

The IF Filter section is specially designed to provide bandpass filter conditions of 3 dB and 6 dB bandwidths. The 3 dB section (when set to AUTO on the 6 dB section) comprises bandwidths of 300 kHz, 100 kHz, 30 kHz, and 10 kHz while the 6 dB section comprises bandwidths of 1.5 MHz, 120 kHz, and 9 kHz. The bandwidth is selected according to the sweep width of the IF frequency while the gain is adjustable by means of a variable gain amplifier included within the IF Filter section.

The RAMP GENERATOR circuit produces a sawtooth output which is used to sweep the X-axis of the CRT tube and the YIG tuned oscillator. For sweeping the YIG tuned oscillator, the sawtooth signal is controlled within the YIG DRIVER by the DISPERSION/DIV switch to set the sweep width between 10 MHz/DIV. and 0.1 MHz/DIV. In addition the YIG DRIVER also receives the tuning voltage input from the TUNING controls to further control the YIG tuned oscillator output.

The CENTER FREQUENCY LED readout displays the frequency set by the TUNING control by utilizing an A/D converter to convert the analog tuning voltage to an equivalent digital voltage. In a similar manner the REFERENCE LEVEL LED readout displays the total amount of attenuation added into the circuit by the RF ATTENUATOR and IF GAIN switches. In the INPUT LEVEL position of the REFERENCE LEVEL switch, the voltages derived from the RF ATTENUATOR and IF GAIN switches are summed and converted via a A/D converter to the digital voltages utilized by the LED display module. In the FIELD STRENGTH positions of the REFERENCE LEVEL switch (Antenna A or B), an antenna coefficient is calculated based on the input tuning voltage from the tuning controls and the type of antenna being utilized. This coefficient is then added to the REFERENCE LEVEL reading.

2.3 CIRCUITRY DESCRIPTION

2.3.1 DC BLOCKING CIRCUIT

This is simply a capacitor inserted between the INPUT connector and the RF ATTENUATOR to block the DC component of an input signal.

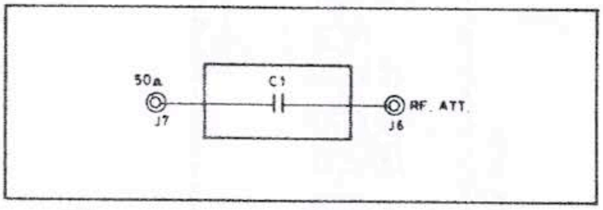


Figure 2.1 DC Blcoking CKT

2.3.2 RF ATTENUATOR CIRCUIT

The RF ATTENUATOR assembly comprises a series of thin film resistors which forms a 10 dB step attenuator with a range of 40 dB.

2.3.3 RADIO FREQUENCY SECTION (RF) BLOCK)

The RF section utilizes a two stage frequency converter to convert the RF input signal from the RF ATTENUATOR into an IF frequency of 46.7 MHz. This section comprises a 1st IF MIXER (Assembly SX052), a 2nd IF MIXER (Assembly SX053) and four tuned cavities.

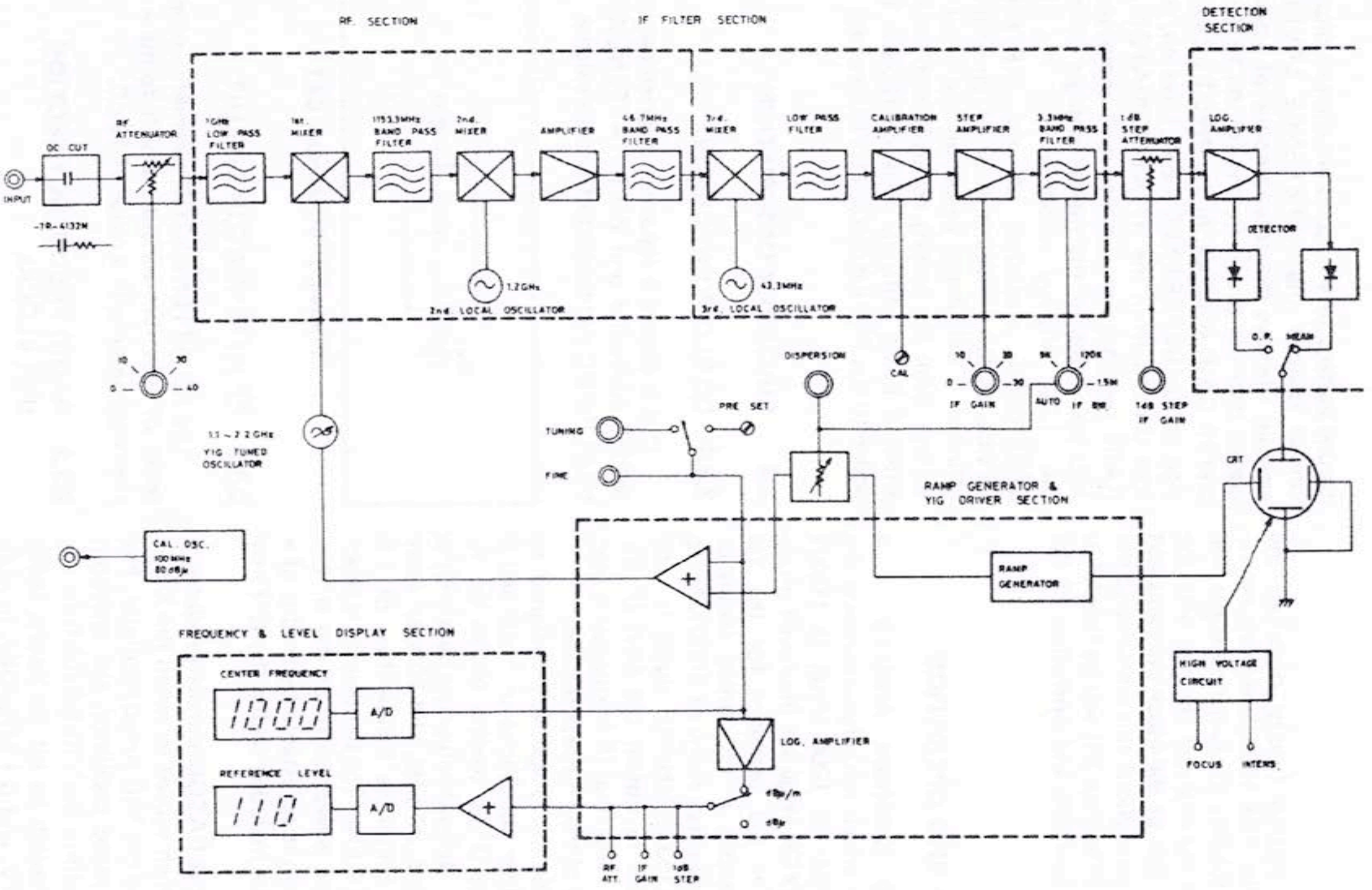

RF. SECTION
IF FILTER SECTION
DETECTION SECTION
INPUT
DC CUT
-19-4132M
RF ATTENUATOR
0
10
30
40
1GHz LOW PASS FILTER
1st. MIXER
1153.3MHz BAND PASS FILTER
2nd. MIXER
1.2GHz
2nd. LOCAL OSCILLATOR
AMPLIFIER
46.7MHz BAND PASS FILTER
3rd. MIXER
43.3MHz
3rd. LOCAL OSCILLATOR
LOW PASS FILTER
CALIBRATION AMPLIFIER
CAL
STEP AMPLIFIER
0
10
20
30
IF GAIN
3.3MHz BAND PASS FILTER
9K
120K
1.5M
AUTO
IF BW
1dB STEP ATTENUATOR
1dB STEP IF GAIN
LOG. AMPLIFIER
DETECTOR
O.P.
MEAN
CRT
HIGH VOLTAGE CIRCUIT
FOCUS
INTENS.
1.1 ~ 2.2 GHz YIG TUNED OSCILLATOR
TUNING
FINE
PRE SET
DISPERSION
RAMP GENERATOR & YIG DRIVER SECTION
RAMP GENERATOR
+
LOG. AMPLIFIER
dBμ/m
dBμ
RF ATT.
IF GAIN
1dB STEP
CAL. OSC. 100MHz 80dBμ
FREQUENCY & LEVEL DISPLAY SECTION
CENTER FREQUENCY
1000
A/D
REFERENCE LEVEL
110
A/D
+

Figure 2.2 ESA-1000 Block Diagram

The input signal from the RF ATTENUATOR is applied to the 1st MIXER stage along with the 1st LO frequency to produce the 1st IF frequency of 1153.3 MHz. The 1st IF frequency then goes via a three stage Band Pass Filter, cavity tuned to 1153.3 MHz, to the 2nd IF MIXER.

The 1st MIXER comprises a strip line low pass input filter with a cutoff frequency of 1 GHz feeding a balanced mixer which minimizes LO feed-through.

The 2nd IF MIXER uses a cavity tuned oscillator to produce the 2nd LO frequency of 1200 MHz. The 1st IF frequency of 1153.3 MHz is loop-coupled to the 2nd LO cavity and then both are applied to a balanced mixer.

The 2nd IF MIXER produces the 2nd IF frequency of 46.7 MHz (difference of 1200 MHz LO and 1153.3 IF) and is applied to a low pass filter composed of C27 and L41. It is then amplified by Q2 and applied to the input of the IF Filter. The conversion gain for the RF section is from - 0.1 dB to +1.0 dB for a 50 ohm load.

2.3.4 IF FILTER SECTION

The IF FILTER section receives the 46.7 MHz IF signal from the RF section, downconverts it to 3.3 MHz, and finally passes it through a four stage band pass filter.

The 46.7 MHz 2nd IF signal from the RF section is supplied via a four stage fixed component bandpass filter to the 3rd IF MIXER stage. The 2nd IF signal is then mixed in a balanced mixer with a 3rd LO frequency of 43.4 MHz. The resultant 3.3 MHz final IF frequency is then applied to a low pass filter composed of C205, L309, and C206.

A variable gain amplifier (composed of Q2 and Q3, see Figure 2.4), controlled by adjustment R79 (GAIN CORRECT), compensates for the IF conversion loss. The front panel CAL adjustment, which controls the bias voltage level on Q3, is used to adjust the amplitude level on the CRT and has a nominal gain range of approximately 4 dB.

Transistors Q4 to Q7 form a 20 dB variable gain amplifier, while transistors Q10 to Q13 form a buffer amplifier with a gain of 10 dB. When the outer section of the front panel IF GAIN switch is set to either the 10 dB or 20 dB position, the gain of the variable amplifier is set to 10 dB or 20 dB depending upon the switch position. In the 30 dB position, the fixed gain 10 dB buffer amplifier is added into the circuit.

The filter section is comprised of a four stage active component band pass filter (comprised of Q8, Q9, Q14, Q15) plus a crystal filter utilized in conjunction with Q16. The center frequency of each stage and the crystal filter is 3.3 MHz. As the front panel 6 dB BANDWIDTH switch is switched, a diode switch in each stage is turned on according to the switch position. This changes the Q of the respective bandpass stage LC resonate circuit which selects a 6 dB bandwidth of 1.5 MHz, 120 kHz, or 9 kHz. The 1.5 MHz bandwidth is determined by the 46.7 MHz band pass filter in front of the 3rd IF MIXER stage. The 120 kHz bandwidth is set by the LC circuits in the crystal filter stage, while the 9 kHz bandwidth is set by placing the crystal filter in series with the LC filter. When the front panel BANDWIDTH switch is set to the AUTO position, bandwidth is controlled by the setting of the DISPERSION/DIV. switch fora 3 dB bandwidth of 300 kHz, 100 kHz, 30 kHz, or 10 kHz. Variation in amplitude level due to the BANDWIDTH switch can be compensated by adjusting R152 (30 kHz – GAIN ADJ.) or R127 (10 kHz – GAIN ADJ.). Transistor Q17 and Q18 form an output amplifier circuit.

The conversion loss through the IF FILTER is approximately 9 dB with the outer section of the IF GAIN switch set to the 0 dB position and the inner section set to the CAL position.

2.3.5 1 dB STEP ATTENUATOR

A 1 dB step attenuator with a range of 12 dB located between the IF FILTER and Log Amplifier section. When the inner section of the front panel IF GAIN switch is set to the CAL position, the attenuation value is 6 dB.

2.3.6 LOG AMPLIFIER SECTION

The Log Amplifier utilized in the ESA-1000 is coincidence-phase saturation amplifier with a gain of 10 dB and nine stages connected in cascade. An approximate value amplifier is formed when the outputs of the four front stages and the rear five stages are summed respectively then added together.

When setting either the Vertical Axis Scale Selector switch to the LINEAR position or the DETECTION MODE switch to the Q.P. (Quasi-Peak) position, the input signal passing through the four front stage amplifiers is amplified in the circuit formed by Q37 and Q38 and then supplied to the detector circuit. If the Vertical Axis Scale Selector switch is set to either the 10 dB/DIV. or 5 dB/DIV. (LOG) positions and the DETECTION MODE switch is set to the MEAN (AVERAGE) position,

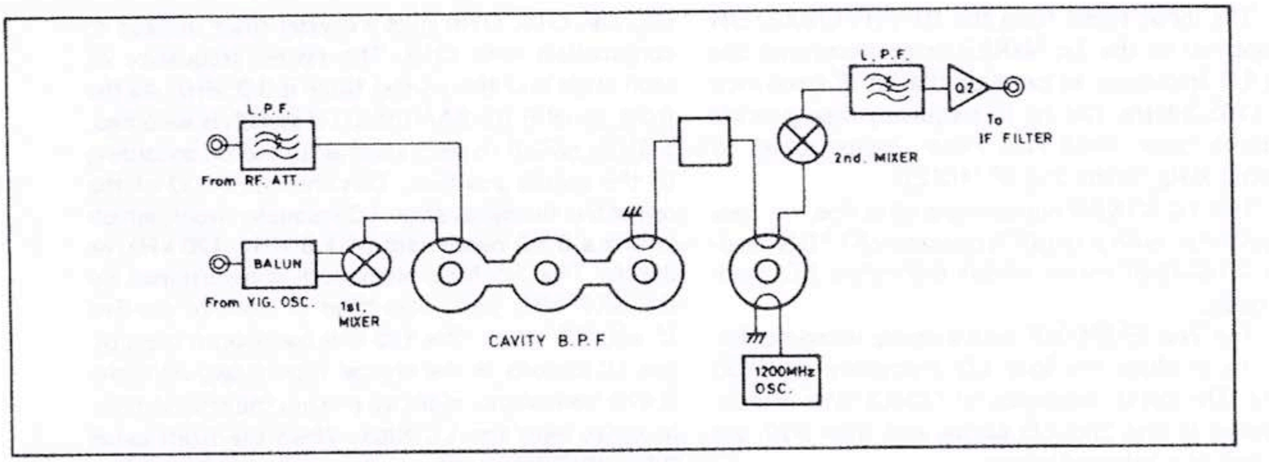

L.P.F.
From RF. ATT.
BALUN
From YIG. OSC.
1st. MIXER
CAVITY B.P.F
L.P.F.
Q2
To IF FILTER
2nd. MIXER
1200MHz OSC.

Figure 2.3 RF Section

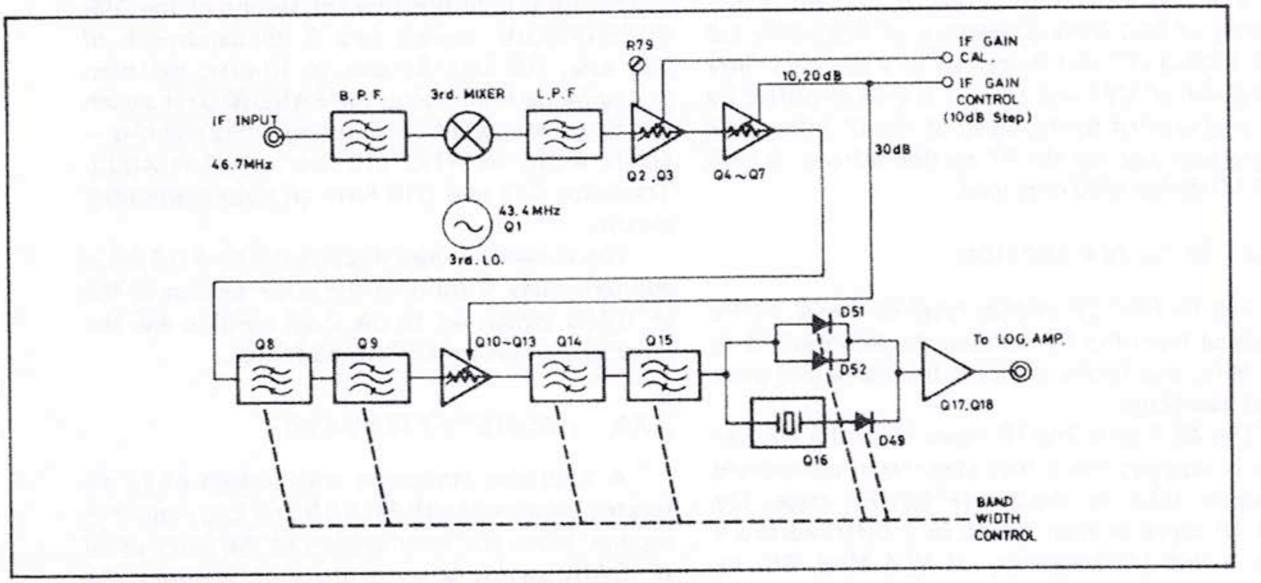

R79
IF GAIN CAL.
10,20dB
IF GAIN CONTROL (10dB Step)
IF INPUT
46.7MHz
B.P.F.
3rd. MIXER
L.P.F
Q2, Q3
Q4 ~ Q7
30dB
43.4MHz Q1
3rd. LO.
Q8
Q9
Q10~Q13
Q14
Q15
D51
D52
To LOG. AMP.
Q17, Q18
Q16
D49
BAND WIDTH CONTROL

Figure 2.4 IF FILTER Section

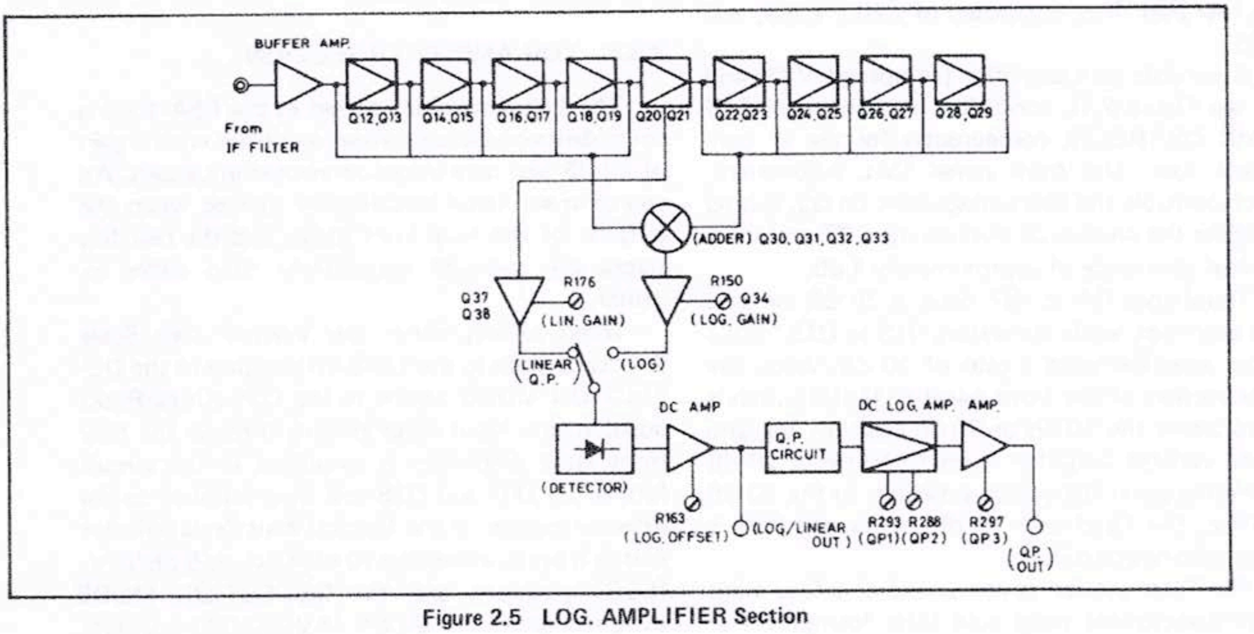

BUFFER AMP.
From IF FILTER
Q12,Q13
Q14,Q15
Q16,Q17
Q18,Q19
Q20,Q21
Q22,Q23
Q24,Q25
Q26,Q27
Q28,Q29
(ADDER) Q30, Q31, Q32, Q33
Q37 Q38
R176
(LIN. GAIN)
R150
Q34
(LOG. GAIN)
(LINEAR Q.P.)
(LOG)
DC AMP
Q.P. CIRCUIT
DC LOG. AMP.
AMP.
(DETECTOR)
R163
(LOG. OFFSET)
(LOG/LINEAR OUT)
R293 R288
(QP1)(QP2)
R297
(QP3)
(QP. OUT)

Figure 2.5 LOG. AMPLIFIER Section

TABLE 2.1

C.I.S.P.R./ESA-1000 Specifications

Frequency Range	0.15 MHz to 30 MHz	25 MHz to 300 MHz	300 MHz to 1000 MHz
6 dB Bandwidth	9 kHz	120 kHz	120 kHz
Detection Time Constant Charge Discharge	 1ms±20% 160ms±20%	 1ms±20% 550ms±20%	 1ms±20% 550ms±20%
ESA-1000 specifications			
Frequency Range	100 kHz to 30 MHz	25 MHz to 1000 MHz	
6 dB Bandwidth	9 kHz	120 kHz	
Detection Time Constant Charge Discharge	 1ms±20% 160ms±20%	 1ms±20% 550ms±20%	

the input signal is logarithmically compressed through all nine stages of the saturation amplifiers, added and applied to Q34 the LOG amplifier. Adjustment R150 (LOG GAIN) is adjusted to provide a DC Log Voltage of 500 mV for a 10 dB change in input signal level.

The detector circuit is applied via a filter network to a DC Amplifier whose output also goes through a filter network to the LOG/LINEAR output. If the DETECTION MODE switch is set to the Q.P. position, the LOG/LINEAR output is applied to a Q.P. detector circuit composed of two operational amplifiers. This circuit provides the time constants needed to meet CISPR specifications. A DC log amplifier, comprising an operational amplifier and a dual transistor Q39, logarithmically converts the Q.P. detector output. It is then applied to the Q.P. OUTPUT via an output amplifier.

2.3.7 RAMP GENERATOR AND YIG DRIVER SECTION

The YIG-tuned oscillator output is utilized by the 1st IF MIXER stage as its variable LO input. The YIG oscillator produces an extremely accurate, stable, and linear output capable of sweeping from 100 kHz to 1000 MHz in 20 milliseconds. The CENTER FREQUENCY LED readout displays the tuned frequency of the instrument by using a A/D converter to convert the tuning control current to a digital representation utilizing the current to frequency linearity of the YIG-tuned oscillator.

The REFERENCE LEVEL LED readout for the CRT reference point can be selected to display either the input terminal voltage levels or input levels in terms of field strength readings when an antenna is being used. The input voltage amplitude level is determined by the RF ATTENUATOR and IF GAIN (outer and inner sections) switch settings. The switch settings are converted to voltager, summed by an adder, and applied to an A/D converter to produce the digital equivalent of the reference level which then displayed on the readout. When field strength reference levels are required, the antenna factor of the antenna being used is automatically added to the input level reading. The voltage which corresponds to the instrument's tuned frequency is derived from the YIG-tuned oscillator's control current. It is logarithmically converted and added to the digital voltage corresponding to the input voltage level.

The ramp generator utilizes an operational amplifier with a capacitor coupled feedback network to form an integrating circuit which produces the ramp waveform. The ramp signal is applied to the CRT Driver circuit and to the front panel DISPERSION/DIV. switch. The DISPERSION/DIV. switch setting attenuates the ramp signal which is then returned to the Ramp Generator and YIG DRIVER board. There it is applied via a buffer to an adder together with the sweep signal to control the sweep width of the YIG oscillator center frequency. The output of the adder is then amplified and used to drive the YIG oscillator coil.

2.3.8 CRT DRIVER SECTION

The ramp voltage supplied by the Ramp Generator and YIG Driver board is amplified by a differential amplifier and applied to the X$^+$ and X$^-$ terminals of the CRT tube.

The Log Amplifier output is applied to a differential amplifier whose feedback level is controlled by FET switch Q27. The FET switch is connected to the 5 dB/DIV. position of the Vertical Axis Scale Selector switch. The circuit is designed so that in the 5 dB/DIV. position, the gain of the differential is double that for the 10 dB/DIV. and LINEAR positions. In addition, Q28 is also activated by the switch to provide an offset to the Y output level. The signal then goes via the VIDEO FILTER network to a differential amplifier whose outputs drive the Y$^+$ and Y$^-$ terminals of the CRT

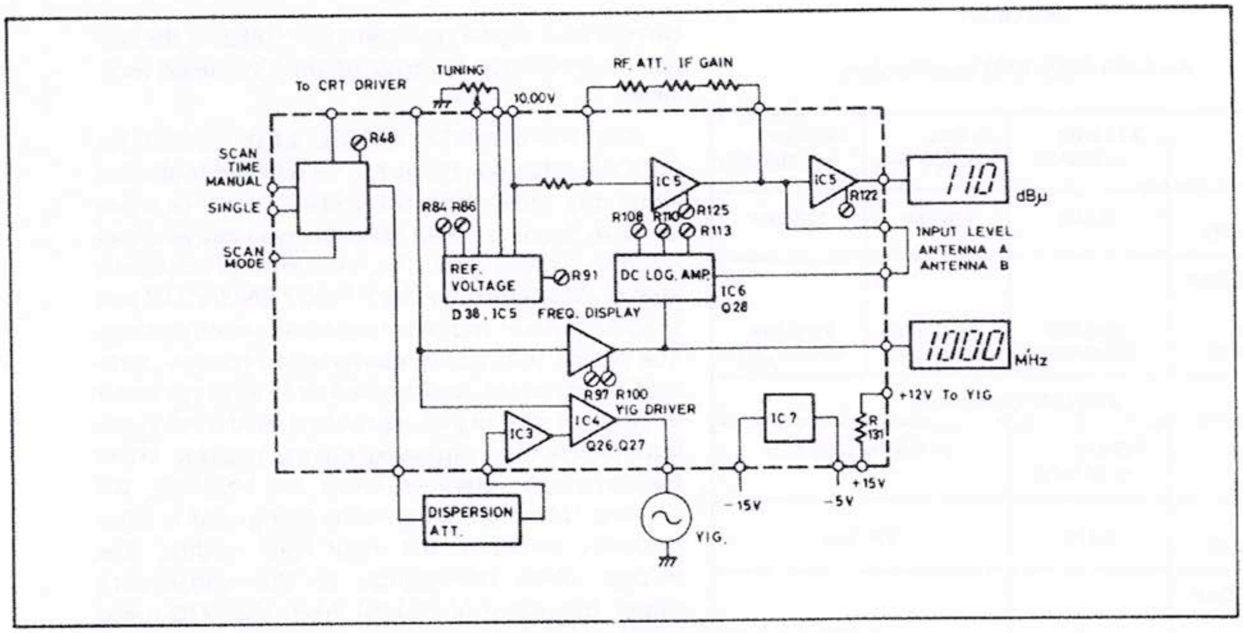

TUNING
RF. ATT. IF GAIN
To CRT DRIVER
10.00V
R48
SCAN TIME MANUAL
SINGLE
SCAN MODE
R84 R86
REF. VOLTAGE
R91
D 38, IC5
FREQ. DISPLAY
IC5
R108 R110 R125
R113
DC LOG. AMP.
IC6 Q28
IC5
R122
110
dBμ
INPUT LEVEL
ANTENNA A
ANTENNA B
1000
MHz
R97 R100
YIG DRIVER
IC4
IC3
Q26, Q27
IC 7
R 131
+12V To YIG
+15V
-15V
-5V
DISPERSION ATT.
YIG.

Figure 2.6 RAMP GENERATOR & YIG DRIVER Section

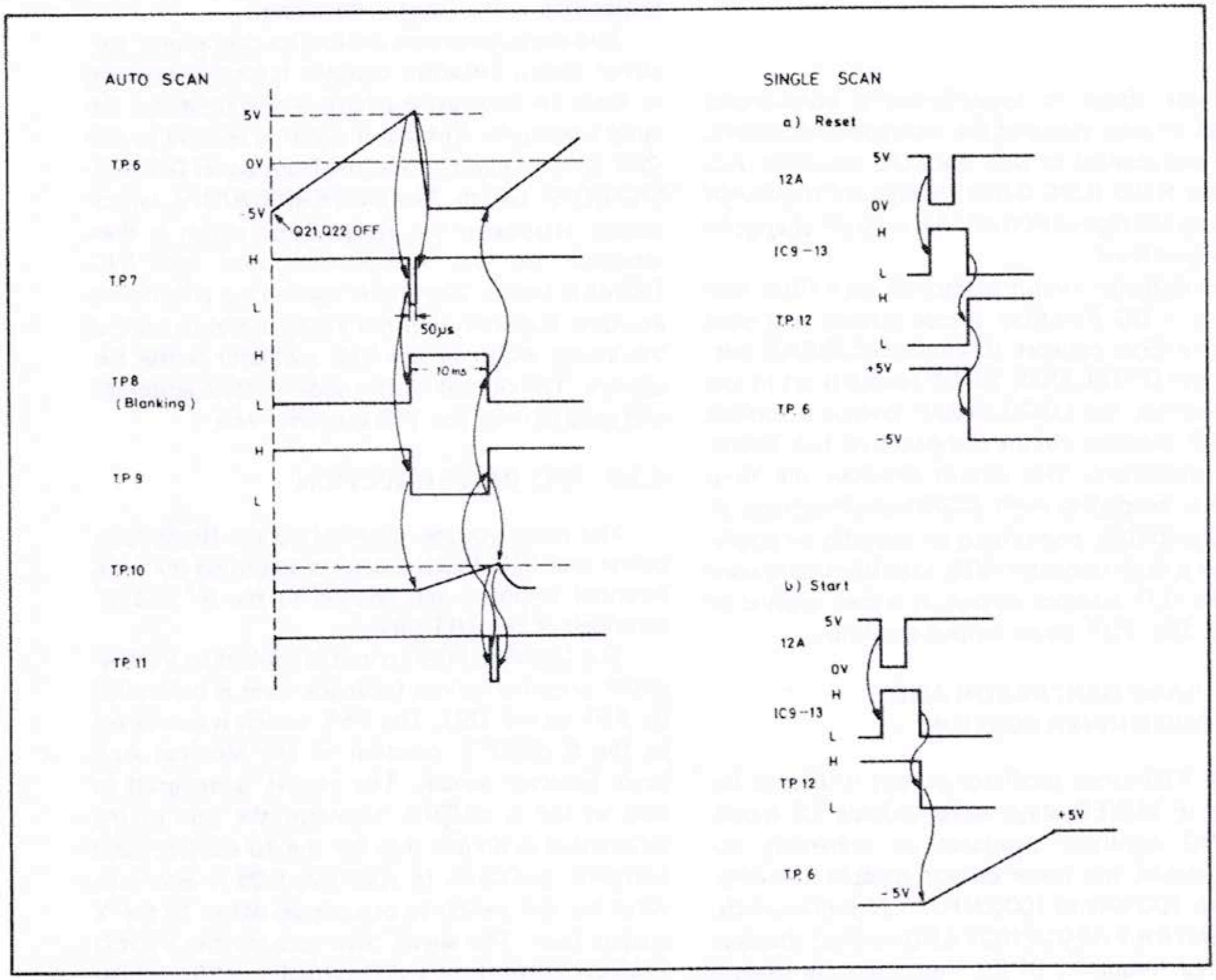

AUTO SCAN
5V
T.P.6
0V
-5V
Q21, Q22 OFF
H
T.P.7
L
50μs
H
TP8 (Blanking)
10 ms
L
H
T.P.9
L
T.P.10
TP 11
SINGLE SCAN
a) Reset
5V
12A
0V
H
IC9-13
L
H
T.P. 12
L
+5V
T.P. 6
-5V
b) Start
5V
12A
0V
H
IC9-13
L
H
TP 12
L
+5V
T.P. 6
-5V

Figure 2.7 Timing Chart in AUTO and SINGLE SCAN Modes

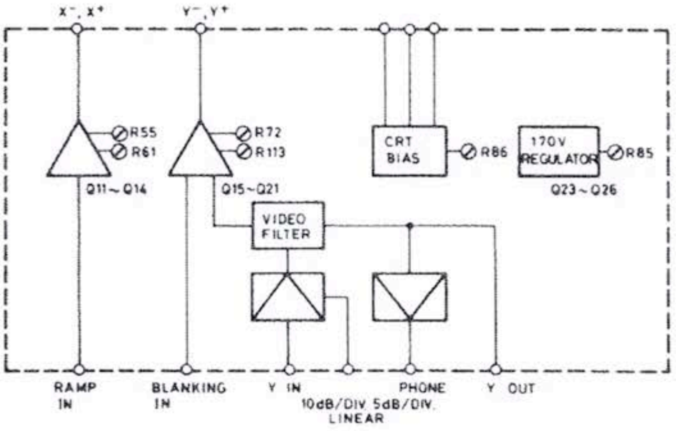

X⁻, X⁺
Y⁻, Y⁺
R55
R61
Q11~Q14
R72
R113
Q15~Q21
CRT BIAS
R86
170V REGULATOR
R85
Q23~Q26
VIDEO FILTER
RAMP IN
BLANKING IN
Y IN
10dB/DIV 5dB/DIV LINEAR
PHONE
Y OUT

Figure 2.8 **CRT DRIVER Section**

tube. The same signal is also applied to the Y output for the X-Y recorder and amplified for use by the front panel PHONE jack.

The board also contains a voltage regulator to produce an output voltage of 170 VDC adjusted by R85.

2.3.9 DISPLAY SECTION

Identical LED displays and A/D converter circuits are utilized for the frequency and reference level readouts. When an analog signal at a level of 1.000 V is applied to the A/D converter in addition to the 10.0 VDC reference level from the Ramp Generator and YIG Driver board; the frequency readout will indicate a digital output of 1000, while the reference level readout will indicate a digital output of 100.

2.3.10 CALIBRATION OSCILLATOR SECTION

The Calibration Oscillator utilizes a Colpitts Circuit to produce a frequency of 100 MHz ± 200 kHz at a level of 80 dBuV ± 0.5 dB. The frequency and output level are adjustable by means of L25 and R16 respectively.

2.3.11 HIGH VOLTAGE SECTION

This section provides the high voltage required to drive the CRT tube. The circuit utilizes a 35 kHz oscillator to drive a transformer whose secondary winding voltages are rectified to produce the approximately 2.0 kV voltage levels required.

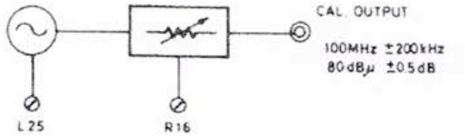

CAL. OUTPUT
100MHz ±200kHz
80dBμ ±0.5dB
L25
R16

Figure 2.9 **CAL. OSC. Section**

SECTION III
Operating Instructions

3.1 GENERAL

This section provides information and instructions for the operation of the Spectrum Analyzer Model ESA-1000.

CAUTION

Read all information in this section before attempting operation. Improper operation may cause costly damage to the instrument.

3.2 OPERATIONAL PRECAUTIONS

3.2.1 AC POWER SOURCE. The ESA-1000 operates from an AC power source of 115 VAC ± 10% 50/60 Hz. Operation from an AC power source other than the one specified could cause extensive circuit damage.

3.2.2 POWER MODE SWITCH. This rear panel switch must be set to the AC position for successful operation from the AC power source.

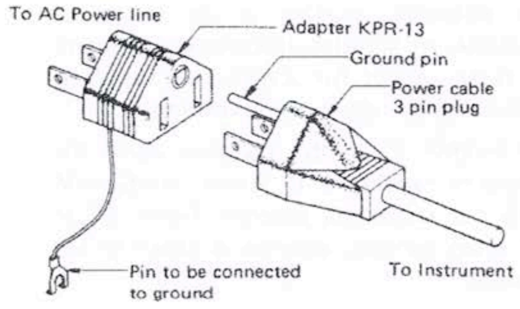


Figure 3.1 Power Cord Plug and Adapter

3.2.3 AC POWER CORD. The front panel AC power switch should always be in the OFF position whenever connecting the AC power cord to the AC power source. This procedure is done to avoid possible damage to the CRT, YIG oscillators, and other critical circuits in the instrument.

3.2.4 GROUNDING. For optimum performance and safety the third prong of the AC power cord must be grounded. When operating from ungrounded power sources, secondary grounding is mandatory. To accomplish this either utilize an adapter plug (See Figure 3.1) or connect a ground wire from the rear panel ground terminal to the nearest available ground source.

3.2.5 The instrument utilizes conduction cooling to remove heat from the higher power circuits within the unit. Therefore it is advisable to keep the rear of the unit free of all obstructions and not to operate the instrument while it is standing on its side.

3.3 CONTROL AND CONNECTOR FUNCTIONS

3.3.1 FRONT PANEL (See Figure 3.2)

NOTE: The circled number corresponds to the same number on Figures 3.2 and 3.3.

1 AC POWER Switch: A maintained action push-button switch which places the instrument in operation when an AC power source is utilized.

2 INTENSITY Control: Controls the brightness of the trace on the CRT DISPLAY.

3 FOCUS Control: Controls the sharpness of the trace on the CRT DISPLAY.

4 TRACE ALIGN Adjustment: This screwdriver adjustment is used to align the trace on the CRT DISPLAY.

5 SCAN MODE Selector: Three position toggle switch that selects the scan mode of the instrument; AUTO, MANUAL, or SINGLE.

- a. AUTO: In this position, the sweep is continuously repeated, with the repetition time controlled by the SCAN TIME control.

b. MANUAL: In this position, the SCAN TIME control is used to manually sweep across the CRT DISPLAY.

c. SINGLE: In this position, only one sweep cycle is initiated whenever the START/RESET switch is pushed, with the sweep time controlled by the SCAN TIME control. At the end of the sweep, a bright spot will remain at the right side of the CRT DISPLAY. When this occurs, the START/RESET switch is pushed which resets the sweep and returns the bright spot to the left side of the CRT DISPLAY. This process is repeated each time the single sweep cycle is utilized.

6 SCAN TIME (MANUAL SCAN) Control: Continuously variable control with locking action at extreme CW position. In the SINGLE or AUTO position of the SCAN MODE switch sets the sweep time over a range of 20 msec. to 10 seconds. In the MANUAL position of the SCAN MODE switch, the SCAN TIME control is used to manually sweep across the CRT DISPLAY.

7 START/RESET Switch: When the SCAN MODE switch is set to SINGLE, this pushbutton switch starts and resets the sweep cycle.

8 CAL OUT Connector: BNC connector for the internal calibration standard. The CAL output signal is 100 MHz at an amplitude level of 80 dBuV and an output impedance of 50 ohms.

9 INPUT Connector: Nominal 50 ohms type N input connector to which the input signal is applied. Input levels should not exceed 130 dBuV or ±50 VDC.

10 RF ATTENUATOR Switch: Adds attenuation to the RF circuits in 10 dB steps, for a total of 40 dB (inner black markings). The outer red markings correspond to an input level which produces a non-distorted level of - 70dB for the second harmonic.

11 IF GAIN Switch: A dual control switch. The outer switch adds attenuation to the IF stage in 10 dB steps over a 30 dB range. The inner switch adds or subtracts attenuation in 1.0 dB steps to the IF stage over the range of - 6.0 dB to +6.0 dB.

12 CAL Adjustment: Variable adjustment which calibrates the CRT display level whenever the inner switch of the IF GAIN switch is set to CAL.

13 Vertical Axis Scale Selector: Three position slide switch which selects the scale reference for the CRT DISPLAY; LINEAR or LOG 10 dB/5 dB per division.

a. LINEAR: In this position, the CRT DISPLAY becomes a linear presentation. The gain level is automatically raised 40 dB and the value displayed on the REFERENCE LEVEL readout is the amplitude level assigned to the top horizontal line of the scale. The bottom horizontal line of the scale is always assigned the value of OV.

b. 10 dB/DIV. LOG: In this position, the CRT DISPLAY becomes a logarithmic presentation with each horizontal scale line representing 10 dB.

c. 5 dB/DIV. LOG: In this position, the CRT DISPLAY is a logarithmic presentation with each horizontal scale line representing 5 dB.

14 REFERENCE LEVEL Readout: An LED display which indicates the amplitude level for the top horizontal line of the CRT DISPLAY to a 1.0 dB resolution.

15 REFERENCE LEVEL Switch: A three position slide switch which selects whether the REFERENCE LEVEL readout indication is in terms of dBuV or dBuV/M. The three positions are INPUT LEVEL, ANTENNA A (DIPOLE), and ANTENNA B.

a. INPUT LEVEL: In this position, the reference reading is in terms of dBuV for normal inputs to the INPUT connector.

b. ANTENNA A (DIPOLE): In this position, the reference reading is in terms of dBuV/M. In addition the respective antenna factor offset for a half-wave dipole is automatically added to the reading.

c. ANTENNA B: In this position, again the reference reading is in terms of dBuV/M with the respective antenna factor offset for a log periodic antenna is added to the reading.

16 DETECTION MODE Switch: A four position toggle switch divided between two detection modes – MEAN (AVERAGE) and Q.P. (Quasi-Peak) plus sub-selected for the MEAN MODE – three ranges of the VIDEO FILTER; OFF, 10 kHz, or 100 Hz.

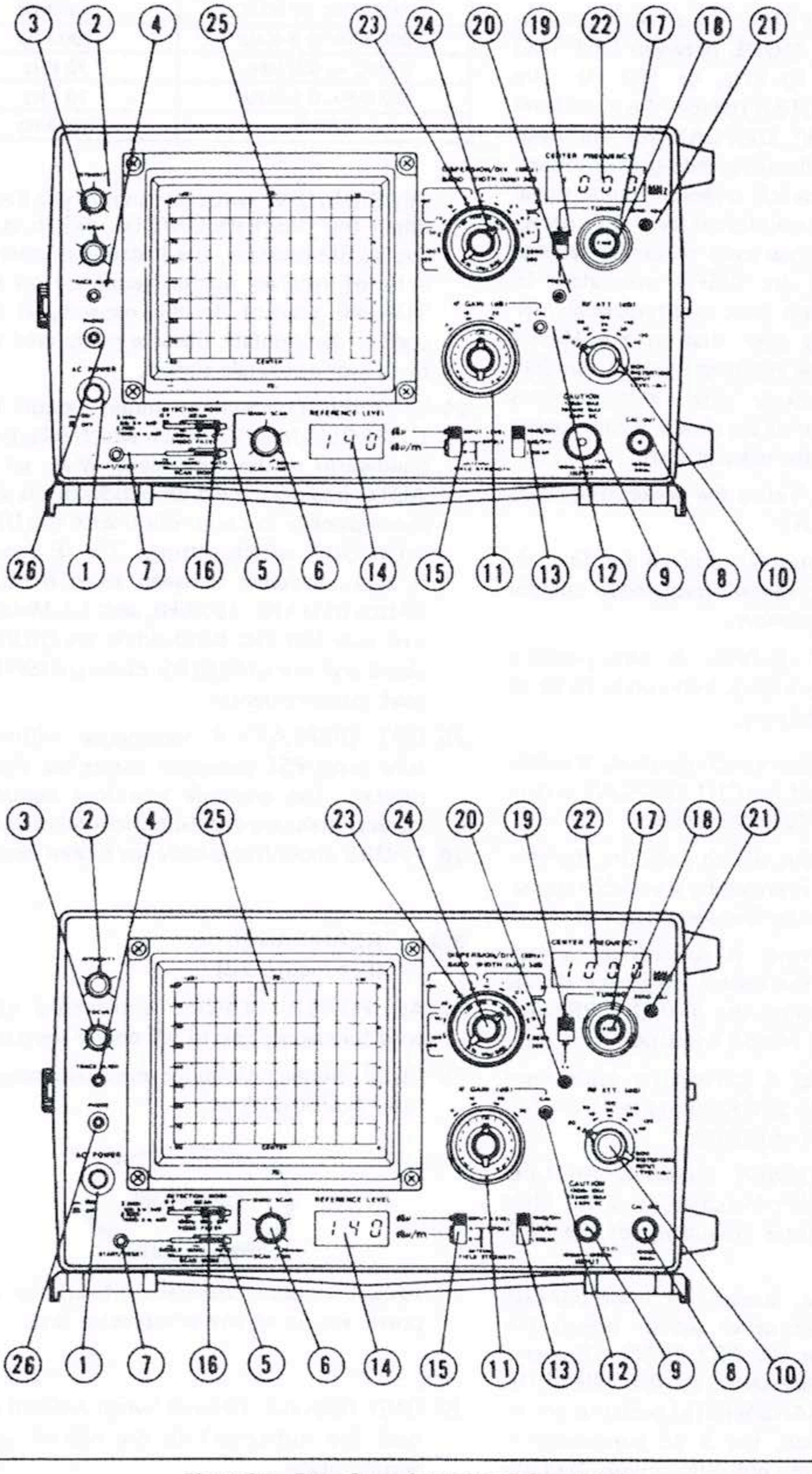

3
2
4
25
23
24
20
19
22
17
18
21
26
1
7
16
5
6
14
15
11
13
12
9
8
10
CENTER FREQUENCY
1000
TUNING
DISPERSION/DIV
BAND WIDTH
IF GAIN (dB)
RF ATT (dB)
CAUTION
INTENSITY
FOCUS
TRACE ALIGN
PHONE
AC POWER
CENTER
DETECTION MODE
SCAN MODE
START/RESET
REFERENCE LEVEL
140
dBμ
dBμ/m
FIELD STRENGTH
INPUT
CAL OUT

Figure 3.2 Front Panel Controls and Connectors

a. MEAN: In this switch position, average detection of an input signal is accomplished by a fast response detection circuit.

   1. VIDEO FILTER: Switchable only in the MEAN MODE between OFF (NO FILTER), 10 kHz, or 100 Hz. The VIDEO FILTER reduces the noise level on the CRT DISPLAY for improved viewing of the detected signal envelope.

b. Q.P.: In this switch position, input signal detection is accomplished by a Q.P. detection circuit whose time constants (charge and discharge) are CISPR mandated. In addition the gain level is automatically increased 40 dB over that in the MEAN mode. Since the response time of the Q.P. mode is relatively slow, measurements should be taken at the slower sweep speeds or by utilizing the manual scan.

17 TUNING Control: Varies the center frequency of the CRT DISPLAY.

18 FINE TUNING Control: Utilized for fine adjustments of the center frequency; control range ±5.0 MHz minimum.

19 TUNING/PRESET Switch: A two position slide switch which selects between a fixed or variable center frequency.

   a. TUNING: In this switch position, the center frequency of the CRT DISPLAY is controlled by the TUNING control.

   b. PRESET: In this switch position, the center frequency is preset by a variable adjustment to the center frequency desired.

20 PRESET Adjustment: A screwdriver adjustment which sets the center frequency of the CRT DISPLAY when the TUNING/PRESET switch is set to the PRESET position.

21 ZERO Adjustment: A screwdriver adjustment which is utilized to zero calibrate the TUNING control to the CRT indication.

22 CENTER FREQUENCY Readout: An LED digital display which indicates, to a 1.0 MHz resolution, the center frequency of the CRT DISPLAY.

23 DISPERSION/DIV. Switch: A multi-position dual switch, whose outer section selects the horizontal axis for the CRT DISPLAY over a range of 100 MHz/DIV. to 0.1 MHz/DIV. When the inner BANDWIDTH switch is set to the AUTO position, the 3 dB bandwidth is automatically set in conjunction with the DISPERSION/DIV. switch settings as per Table 3.1 When the DISPERSION/DIV. switch is set to the ZERO position, the instrument operates as a tuned receiver at the frequency set by the TUNING control. In this capacity it can be used to demodulate, observe modulated signals, or to monitor single signals.

TABLE 3.1 Automatic Bandwidth Determination

DISPERSION/DIV.	3 dB bandwidth
100 MHz, 50 MHz	300 kHz
200 MHz to 5 MHz	100 kHz
2 MHz to 0.5 MHz	30 kHz
0.2 MHz, 0.1 MHz	10 kHz
ZERO	300 kHz

24 BANDWIDTH Switch: Inner section of the DISPERSION/DIV. switch which selects the IF bandwidth of the instrument. When set to the AUTO position, the 3 dB bandwidth is selected automatically in conjunction with the DISPERSION/DIV. switch settings. The IF bandwidth is also selectable between three 6 dB bandwidths of 9 kHz, 120 kHz, and 1.5 MHz. The 9 kHz and 120 kHz bandwidths are CISPR mandated and are utilized for making CISPR quasi-peak measurements.

25 CRT DISPLAY: A rectangular cathode ray tube with P31 phosphor comprises the visual display. The graticule markings comprises 8 vertical divisions and 10 horizontal divisions.

26 PHONE Jack: Receptacle for 8-ohm earphones.

3.3.2 REAR PANEL
(See Figure 3.3)

27 AC POWER CORD: Permanently attached cord for connection to AC power source.

28 FUSE Holder: Contains main AC power line fuse - 0.5 slow blow.

CAUTION

Always remove instrument from the AC power source whenever replacing fuse.

29 GND Terminal: Utilized (when needed) to connect the instrument to the nearest available ground plane.

30 POWER MODE Switch: A two position slide switch which selects the instrument's power source (AC or DC).

a. AC: In this switch position, the unit utilizes the nominal AC power source.

b. DC: In this switch position, the unit utilizes the external BAT-1000 Battery Pack.

31 EXTERNAL DC INPUT Connector: The power cable for the external BAT-1000 Battery Pack is connected here for external DC operations.

32 X OUTPUT Connector: BNC connector for the horizontal (X) output. Output level approximately ±5.0 V, at an impedance of 10 K.

33 Y OUTPUT Connector: BNC connector for the vertical (Y) output. Output level approximately 0 to 3.5 V, at an impedance of 10 K.

3.4 OPERATING PROCEDURE

This section covers the initial power turn on and calibration procedures.

3.4.1 GENERAL POWER UP PROCEDURE

3.4.1.1 Before power is applied to the ESA-1000 the following should be checked:

a. The AC power source is 115 VAC ±10%, 50/60 Hz.

b. The rear panel POWER MODE switch is set to the AC position.

c. The front panel AC power switch is set to OFF.

3.4.1.2 Set the ESA-1000 front panel controls as follows:

INTENSITY	center position
FOCUS	center position
SCAN MODE	AUTO
DETECTION MODE	MEAN (VIDEO FILTER-OFF)
SCAN TIME (MANU. SCAN)	20ms
REFERENCE LEVEL	INPUT LEVEL
VERTICAL AXIS SCALE SELECTOR	10 dB/DIV.
IF GAIN (dB)	20 dB, CAL.
RF. ATT. (dB)	10 dB
DISPERSION/DIV.	100 MHz/DIV.
B.W. (Hz) 6 dB	AUTO
TUNING/PRESET	TUNING
CENTER FREQUENCY	000 MHz

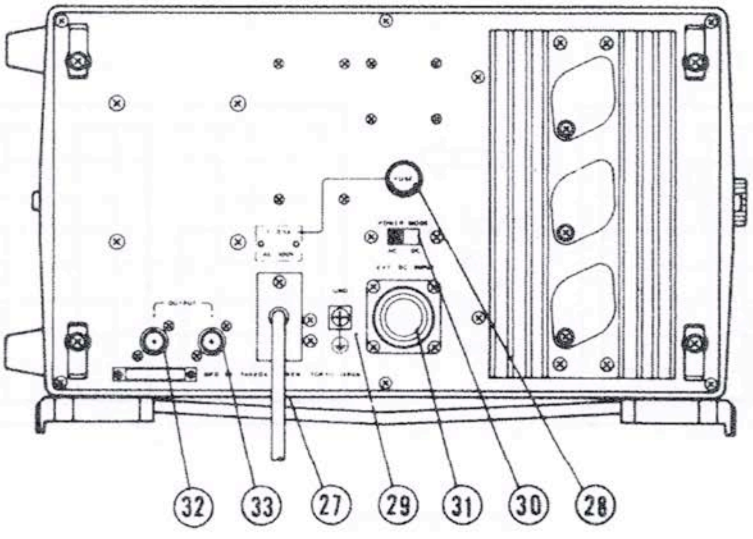


Figure 3.3 Rear Panel Controls and Connectors

3.4.1.3 Connect the AC power cord to the AC power source and energize the instrument by pushing the AC POWER switch to the ON position.

3.4.1.4 A zero frequency trace should appear on the CRT DISPLAY after approximately 20 seconds. If a trace fails to appear, turn the INTENSITY control clockwise until the trace appears. Always adjust the INTENSITY control for optimum brightness according to the viewing conditions encountered.

CAUTION

The CRT may be damaged by excessive intensity for long periods of time.

3.4.1.5 Use the FOCUS control to obtain maximum sharpness of the CRT trace. Always use the FOCUS control in conjunction with the INTENSITY control to obtain a sharp and distinct trace.

3.4.1.6 If the trace is not aligned with the horizontal graticule markings of the CRT DISPLAY, adjust the TRACE ALIGN adjustment to correctly align the trace to the horizontal markings (See Figure 3.4).

3.4.1.7 Before proceeding with this and the following steps, allow a minimum warmup period of 30 minutes. After the warmup period, set the FINE TUNE control to its mechanical center and adjust the TUNING control to position the zero frequency trace at the center of the CRT DISPLAY.

NOTE: The FINE TUNE control is a 3 turn adjustment with a minimum adjustment range of 10 MHz. It is normally utilized whenever the DISPERSION/DIV. switch is set to 0.5 MHz/DIV. or lower for easier tuning control.

Adjust the ZERO ADJUSTMENT to set the CENTER FREQUENCY readout to 000 (if needed).

3.4.1.8 Connect the CAL. OUT output to the INPUT connector. (Use the type N to BNC adapter on the INPUT). The CAL signal spectrum displayed on the CRT will appear as per Figure 3.5.

3.4.1.9 The reference level for the top horizontal line of the CRT graticule, as indicated by the REFERENCE LEVEL readout, is 100 dBuV (es-

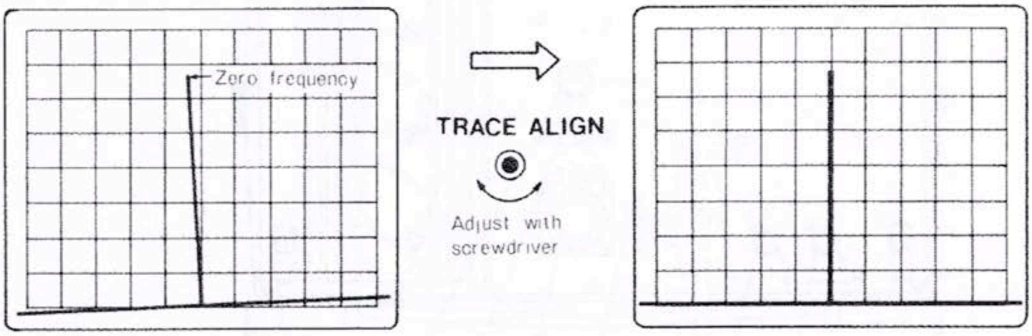


Figure 3.4 Trace Align Adjustment

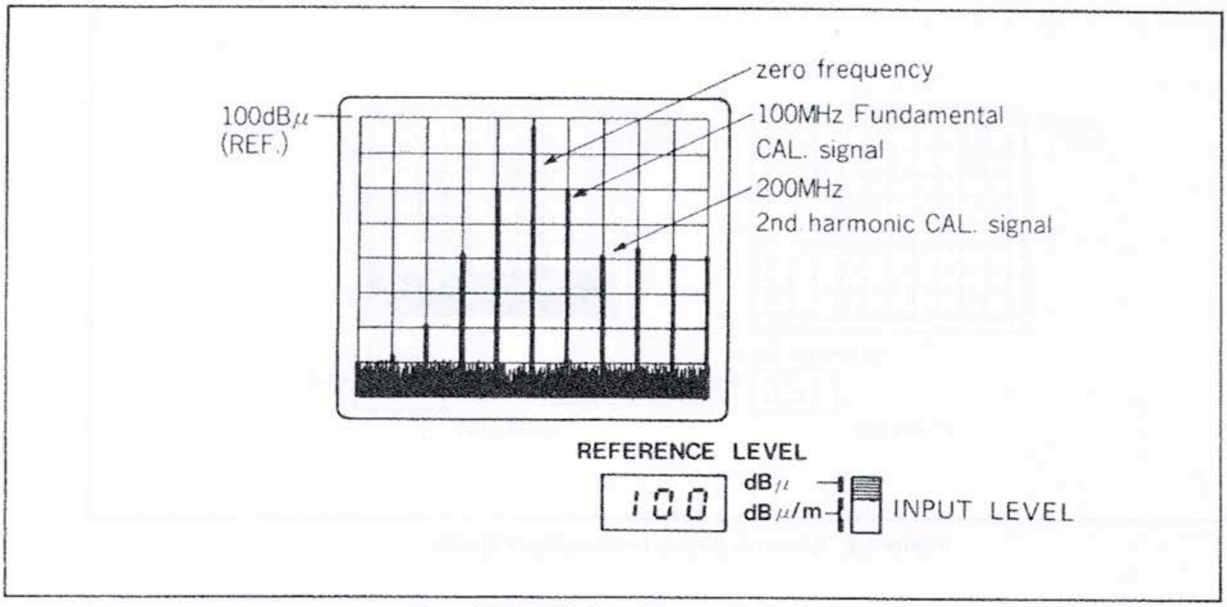


Figure 3.5 CAL. Signal Spectrum display

tablished by initial control settings). The CAL OUT signal is at a frequency of 100 MHz with an amplitude level of 80 dBuV, therefore the signal amplitude level should be 2 divisions or 20 dB down from the reference point (see Figure 3.5). If not, utilize the IF GAIN CAL adjustment (inner switch at CAL) to set the amplitude level to 80 dBuV.

NOTE: In addition to the spectrum display to the right of the zero frequency point, a mirror image will also appear on the left side. Since the levels and frequencies are not accurately displayed, they should not be used for measurement purposes.

3.4.1.10 Rotate the outer section of the IF GAIN switch clockwise (from 20 dB to 30 dB) and note that the signal level on the CRT increases by 10 dB, while the REFERENCE LEVEL readout decreases by 10 dB (100 dBuV to 90 dBuV). (NOTE: The noise level will also increase for this step.) (See Figure 3.6.)

3.4.1.11 Next rotate the switch counterclockwise (from 30 dB to 0 dB); note that the results are the reverse of 3.4.1.10 (e.g. as the IF GAIN decreases, the CRT signal level decreases and the REFERENCE LEVEL increases). (See Figure 3.6.)

3.4.1.12 Rotate the inner section of the IF GAIN switch in a clockwise direction (increasing IF GAIN in 1 dB steps) and again, as per 3.4.1.10, the signal level on the CRT increases in 1 dB steps while the REFERENCE LEVEL readout decreases in 1 dB increments.

3.4.1.13 Rotate the switch in a counterclockwise direction (+6 dB to -6 dB) and note that the results are the reverse of 3.4.1.12 (e.g. the CRT signal level decreases and REFERENCE LEVEL readout increases.)

3.4.1.14 Increase the RF ATTENUATOR switch in a clockwise direction (10 dB to 40 dB) and note that the signal level on the CRT decreases in 10 dB steps, while the REFERENCE LEVEL readout increases in 10 dB increments.

NOTE: Whenever the RF ATTENUATOR switch is set to 0 dB, the amplitude level of the zero frequency trace may vary. This variance of the zero frequency level has effect on the unit's measurement accuracy.

3.4.1.15 To expand a selected signal spectrum, the DISPERSION/DIV. switch is utilized in the following manner:

a. The BANDWIDTH switch is set to AUTO.

b. The TUNING control is utilized to position the signal to be observed at the center of the CRT DISPLAY (see Figure 3.7).

c. The DISPERSION/DIV. switch is turned clockwise to expand the selected signal spectrum. Use the TUNING control to keep the signal position at the center of the CRT DISPLAY.

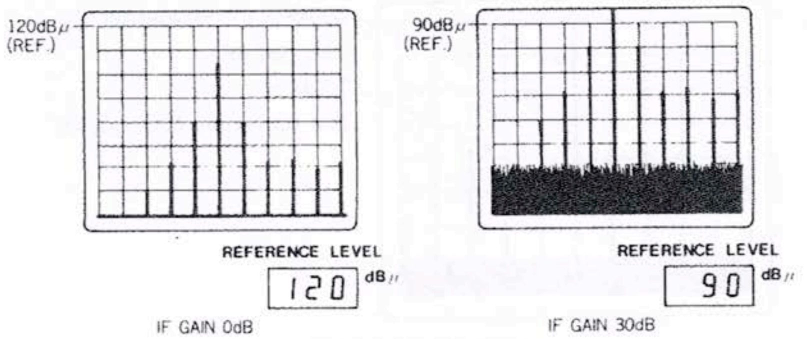

120dBμ
(REF.)
REFERENCE LEVEL
120 dBμ
IF GAIN 0dB
90dBμ
(REF.)
REFERENCE LEVEL
90 dBμ
IF GAIN 30dB

Figure 3.6 Spectrum display by changing IF GAIN

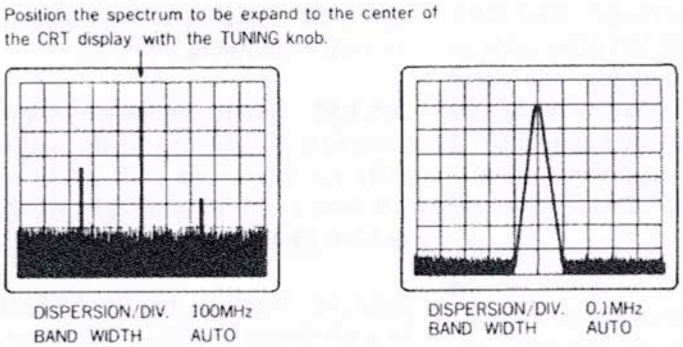

Position the spectrum to be expand to the center of the CRT display with the TUNING knob.
DISPERSION/DIV. 100MHz
BAND WIDTH AUTO
DISPERSION/DIV. 0.1MHz
BAND WIDTH AUTO

Figure 3.7 Expansion of an Arbitrary Spectrum

3.4.2 DAILY CALIBRATION

Before making signal measurements, it is recommended that the instrument's amplitude level accuracy and CRT DISPLAY accuracy be checked and, if necessary, calibrated on a daily basis.

3.4.2.1 Amplitude Level Calibration.

3.4.2.1.1 Set the ESA-1000 front panel controls as follows:

RF ATT. ....10 dB
IF GAIN ....20 dB, CAL.
TUNING PRESET .... TUNING
DISPERSION/DIV. ....50 MHz/DIV.
B.W. (Hz) 6 dB .... AUTO
VERTICAL AXIS SCALE SELECTOR.....................10 dB/DIV.
REFERENCE LEVEL ....INPUT LEVEL
SCAN MODE .... AUTO
SCAN TIME ....20 ms
DETECTION MODE .... MEAN (VIDEO FILTER-OFF)
CENTER FREQUENCY .... 100 MHz

3.4.2.1.2 Connect the CAL OUT signal to the unit's INPUT connector.

3.4.2.1.3 A signal spectrum as per Figure 3.8 should appear on the CRT DISPLAY. The 100 MHz fundamental signal amplitude level should be 2 divisions or 20 dB below the top reference line, if not utilize the IF GAIN CAL adjustment to set the correct amplitude level.

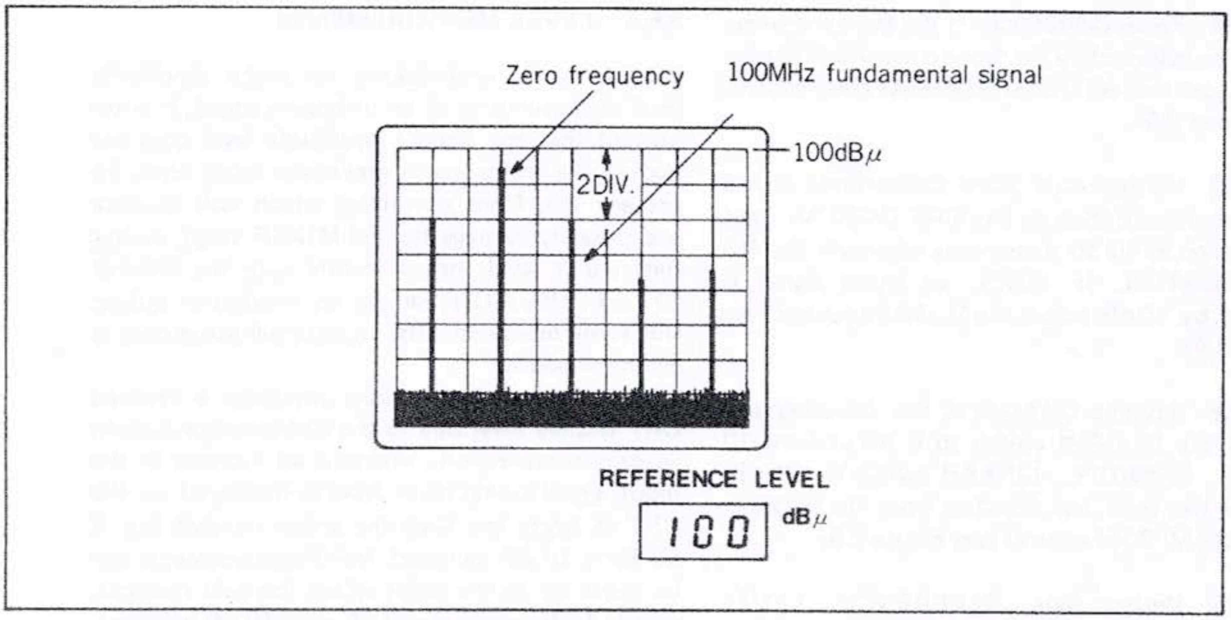

Zero frequency
100MHz fundamental signal
100dBμ
2DIV.
REFERENCE LEVEL
100
dBμ

Figure 3.8 dBμ Calibration display

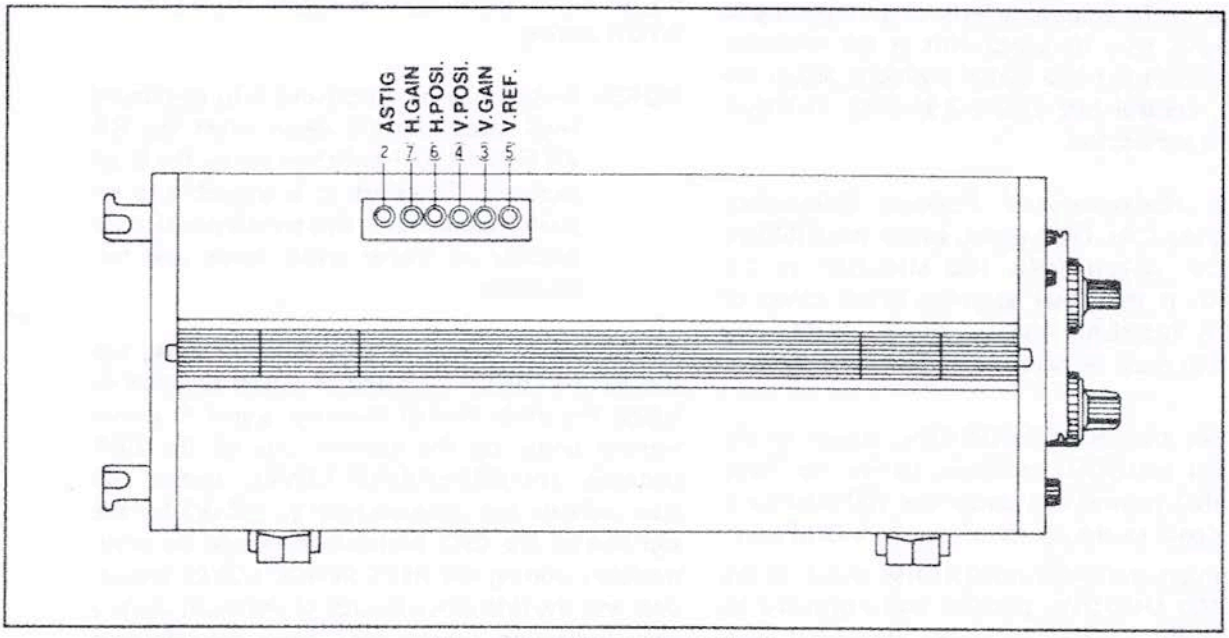

ASTIG
H.GAIN
H.POSI.
V.POSI.
V.GAIN
V.REF.
2
7
6
4
3
5

Figure 3.9 CRT Display Calibration

3.4.2.1.4 The CRT DISPLAY is now calibrated in terms of dBuV for amplitude level readings.

3.4.2.2 CRT DISPLAY Calibration.

3.4.2.2.1 A series of screwdriver adjustable calibration controls are located on the left upper side of the unit (see Figure 3.9). These adjustments are utilized for calibration of the CRT DISPLAY functions whenever waveform distortions or amplitude level inaccuracies cannot be corrected by the normal front panel control adjustments.

Whenever such calibration is required, allow a minimum 30 minute warmup period for the instrument to achieve uniform temperature stabilization.

3.4.2.2.2 Set the ESA-1000 front panel controls as per 3.4.2.1.1.

3.4.2.2.3 Trace Alignment Calibration: See 3.4.1.6 and Figure 3.4

3.4.2.2.4 Focus Calibration: If the trace sharpness cannot be adjusted by the front panel FOCUS control; adjust the ASTIG. (ASTIGMATISM) control (see Figure 3.9).

3.4.2.2.5 Vertical-Axis Scale Calibration: If the signal amplitude level on the CRT DISPLAY does not change in 10 dB increments whenever the RF ATTENUATOR, IF GAIN, or input signal is changed by 10 dB; adjust the V. GAIN control (see Figure 3.9).

3.4.2.2.6 Baseline Calibration: Set the outer section of the IF GAIN switch to 0 dB and the 10 dB/DIV., 5 dB/DIV., LINEAR switch to 10 dB/DIV. If the trace has deviated from the baseline, adjust the V. POSI control (see Figure 3.9).

3.4.2.2.7 Vertical-Axis REFERENCE LEVEL Calibration: Switch the Vertical Axis Scale Selector switch between the 10 dB/DIV. and 5 dB/DIV. positions. If the amplitude level of an input signal (CAL signal may be used) shift at the reference point between the two switch positions, adjust the V. REF. control (see Figure 3.9) until no amplitude shift is detected.

3.4.2.2.8 Horizontal-Axis Position Calibration: Utilizing the CAL OUT signal, switch the DISPERSION/DIV. switch from 100 MHz/DIV to 0.1 MHz/DIV. If the signal spectrum at the center of the CRT DISPLAY moves, the H. POSI. (see Figure 3.9) must be adjusted in the following manner:

a. Set the DISPERSION/DIV. switch to the 0.1 MHz/DIV. position. Utilize the TUNING control and center the 100 MHz CAL signal to the center of the CRT DISPLAY.

b. Reset the DISPERSION/DIV. switch to the 100 MHz/DIV. position and adjust the H. POSI. control to center the signal spectrum.

3.4.2.2.9 Horizontal-Axis Scale Calibration: Again utilizing the CAL OUT 100 MHz signal and with the DISPERSION/DIV. switch set to the 100 MHz/DIV. position; the horizontal axis scale of the CRT DISPLAY should be 100 MHz per division. If not, adjust the H. GAIN control (see Figure 3.9) for the correct scale setting.

3.5 BASIC APPLICATIONS

3.5.1 LEVEL MEASUREMENTS

3.5.1.1 When undertaking to make amplitude level measurements of an unknown signal, it is important that the signal's amplitude level does not exceed the instrument's maximum input level. To prevent this from occurring, which will saturate and possibly damage the 1st MIXER stage, always start signal level measurements with the internal RF ATTENUATOR set to its maximum setting (for some measurements, an external attenuator is recommended).

Saturation of the mixer produces a lowered CRT display level due to the phenomenon known as gain compression, whereby an increase in the input signal's amplitude level is displayed on the CRT as being less than the actual increase (e.g. 8 dB for a 10 dB increase). Valid measurements can be made up to the point where the gain compression is 1 dB or less (e.g. 9 dB for a 10 dB increase). For the ESA-1000, gain compression is less than -1 dB for a 100 dBuV input at a 0 dB RF ATTENUATOR setting.

NOTE: Errors may be introduced into amplitude level measurements taken when the RF ATTENUATOR switch is set to the 0 dB position. Therefore it is advisable to refrain from utilizing this switch position especially at higher input levels and frequencies.

3.5.1.2 After tuning in an unknown signal, use the RF ATTENUATOR and IF GAIN switches to adjust the peak level of the input signal to a convenient point on the vertical axis of the CRT graticule. The REFERENCE LEVEL readout will now indicate the absolute level (in dBuV) for the top line of the CRT graticule markings. By arithmetically adding the REFERENCE LEVEL indication and the difference (in dB) of the input signal's peak indication on the CRT from the reference point, the result will be the level of the input signal in dBuV. For example: Assume that the vertical-axis scale is set to 10 dB/DIV. and the signal amplitude level has been set by the RF ATTENUATOR and IF GAIN switches to 2 divisions or 20 dB below the reference point. If the value on the REFERENCE LEVEL readout is 108 dBuV, the level of the input signal will be 108 dBuV + (-20 dB) = 88 dBuV (see Figure 3.10).

3.5.1.3 By keeping the RF ATTENUATION and IF GAIN settings the same and changing the Vertical Axis Scale Selector to 5 dB/DIVISION, the res-

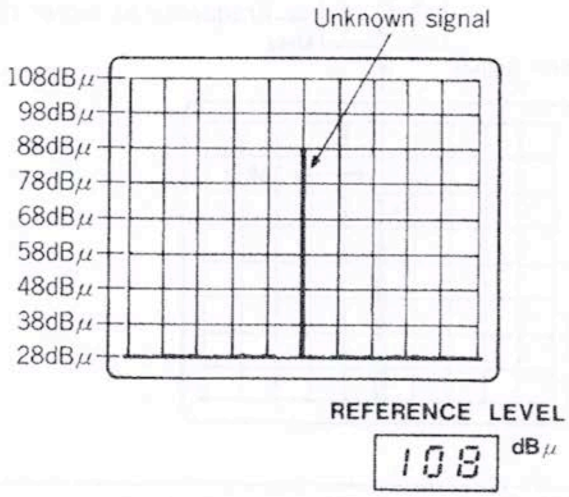


Figure 3.10 Absolute Level Measurement Display

olution of the CRT DISPLAY will be enlarged by a factor of two with the reference point unchanged. Under these conditions, it is recommended that the Amplitude Level calibration procedure of Section 3.4.2.1 be performed prior to taking measurements.

3.5.1.4 In the LINEAR position of the Vertical Axis Scale Selector, the CRT DISPLAY becomes a linear presentation while the internal gain of the unit is increased by 40 dB. Again the REFERENCE LEVEL readout indicates the absolute level of the top scale line (reference point) while the bottom scale line is always equal to 0.0 Volts. Because of the 40 dB gain difference between the LOG and LINEAR scales, whenever utilizing the LINEAR position the RF ATTENUATOR and IF GAIN switches will have to be readjusted to keep the signal trace on the CRT DISPLAY. An example of the relationship between the REFERENCE LEVEL readout indication and the linear sealing on the CRT DISPLAY is given in Table 3.2. As can be seen each 20 dB increase, increases the voltage reading by a factor of 10.

TABLE 3.2

Relation of REFERENCE LEVEL and LINEAR Scale

Reference Level Display	Linear Scale
104 dBμV	20mV/DIV.
98 dBμV	10mV/DIV.
84 dBμV	2mV/DIV.
78 dBμV	1 mV/DIV.
65 dBμV	200 μV/DIV.
58 dBμV	100 μV/DIV.
44 dBμV	20 μV/DIV.
38 dBμV	10 μV/DIV.

3.5.2 FREQUENCY MEASUREMENT

There are three methods by which the frequency of an input signal can be measured with the spectrum analyzer:

a. Absolute Value Method

b. Zero Frequency Method.

c. Reference Signal Method.

Before proceeding with any of the three methods of frequency determination, see Section 3.4 (Operating Procedure) and set the ESA-1000 front panel controls as per Section 3.4.1.2 except for the following: Set the RF ATTENUATOR switch to its 40 dB position.

NOTE: When performing measurements (level, frequency, etc.) of unknown signals, always start with the RF ATTENUATOR

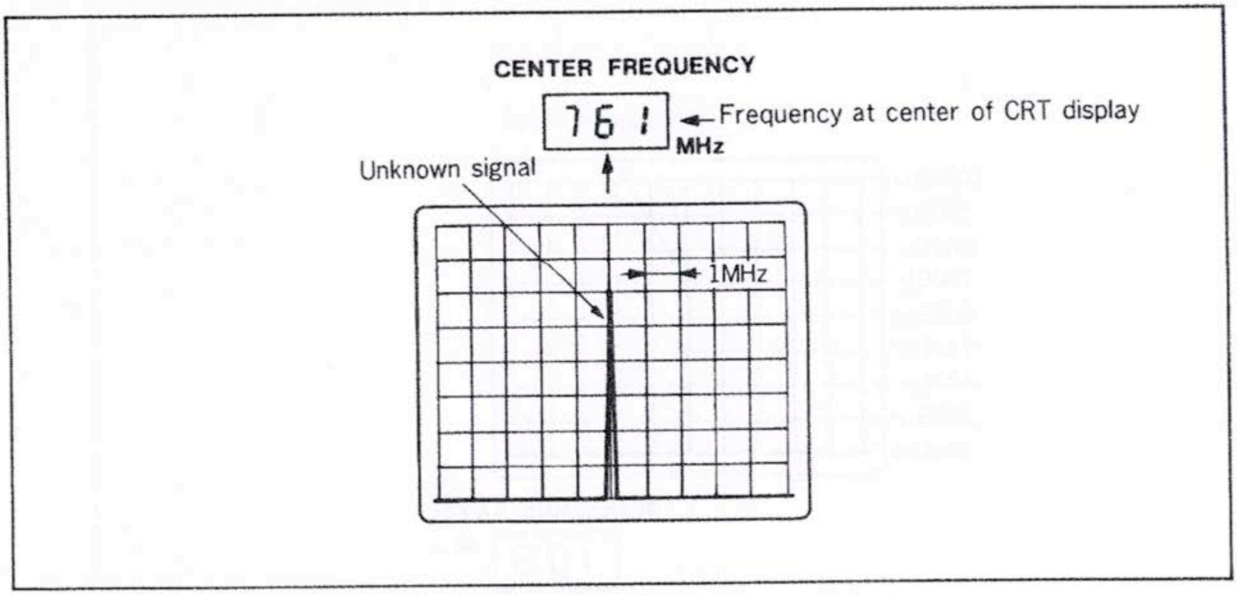
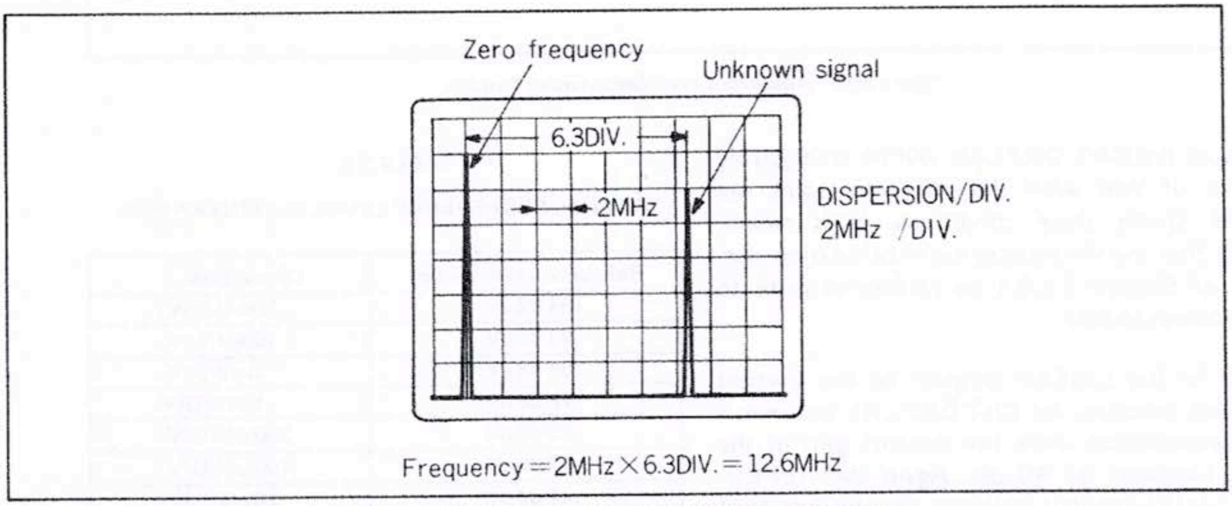
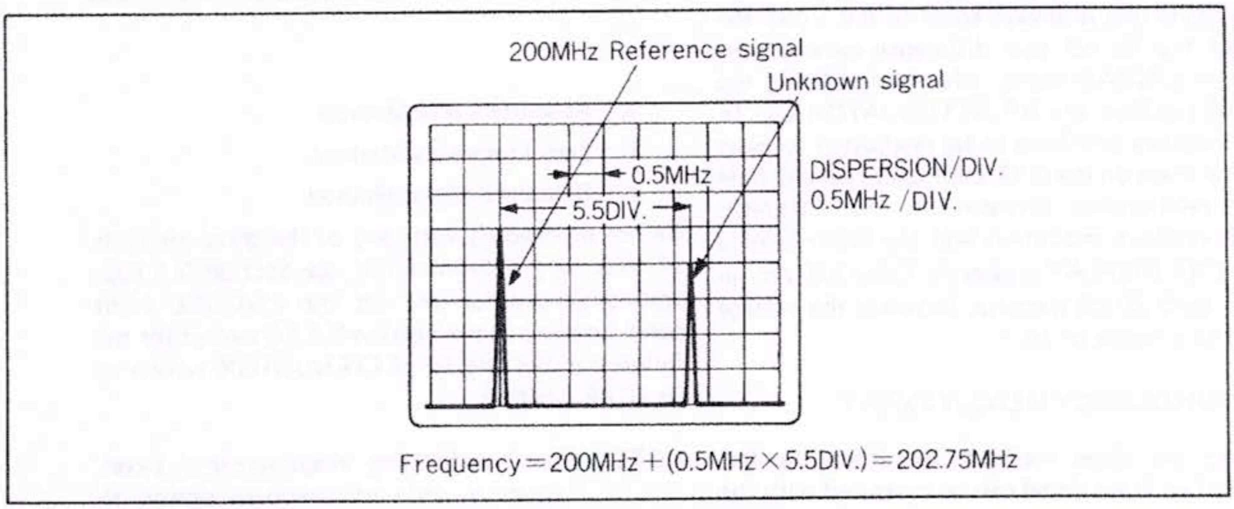

CENTER FREQUENCY
761
MHz
Frequency at center of CRT display
Unknown signal
1MHz

Figure 3.11 Absolute Frequency Measurement Procedure


Zero frequency
Unknown signal
6.3DIV.
2MHz
DISPERSION/DIV.
2MHz /DIV.

Frequency = 2MHz × 6.3DIV. = 12.6MHz

Figure 3.12 Measurement Relative to Zero Frequency


200MHz Reference signal
Unknown signal
0.5MHz
5.5DIV.
DISPERSION/DIV.
0.5MHz /DIV.

Frequency = 200MHz + (0.5MHz × 5.5DIV.) = 202.75MHz

Figure 3.13 Measurement Relative to Reference Signal

switch set for maximum attenuation (40 dB). Use the RF ATTENUATOR and IF GAIN switches in conjunction with each other to set the input signal amplitude level to a convenient point on the CRT DISPLAY.

3.5.2.1 ABSOLUTE VALUE METHOD

3.5.2.1.1 With an unknown signal applied to the unit, set the DISPERSION/DIV. switch to the 1 MHz/DIV. position and use the TUNING control to center the zero frequency trace on the CRT DISPLAY.

3.5.2.1.2 Use a screwdriver to adjust the ZERO ADJUST to set the CENTER FREQUENCY readout to 000.

3.5.2.1.3 Use the TUNING control to position the unknown signal to be measured at the center of the CRT DISPLAY. The frequency of the unknown signal will now be indicated on the CENTER FREQUENCY readout to an error of ±10 MHz (see Figure 3.11).

3.5.2.2 ZERO FREQUENCY METHOD

3.5.2.2.1 With an unknown signal applied to the unit, set the DISPERSION/DIV. switch to a setting which will allow both the zero frequency trace and the input signal to be observed simultaneously on the CRT DISPLAY.

3.5.2.2.2 Note the difference between the two traces on the CRT DISPLAY and find the frequency of the unknown signal by multiplying this value by the setting of the DISPERSION/DIV. switch (see example in Figure 3.12). The error for this method is ±5% of the actual signal frequency.

3.5.2.3 REFERENCE SIGNAL METHOD

3.5.2.3.1 Simultaneously apply the unknown signal and a stable known reference signal to the INPUT of the unit. Set the DISPERSION/DIV. switch to a minimum setting which allows both signal traces to be observed on the CRT DISPLAY.

3.5.2.3.2 Note the difference between the two signals on the CRT DISPLAY and calculate the frequency of the unknown signal by utilizing the following equation (see example in Figure 3.13):

$$fx = fr + (fd \times Ds)$$

where

fx = unknown signal frequency
fr = reference signal frequency
fd = DISPERSION/DIV. setting
Ds = difference between the two signal traces.

NOTE: If the unknown signal is to the right of the reference signal, the difference will have a positive value. If the unknown signal is to the left of the reference signal, the difference will have a negative value.

If an external source is not available for use as a reference signal, the 100 MHz CAL OUT signal contains harmonics which can be conveniently utilized for the reference signals.

TABLE 3.3 Automatic IF Bandwidth Selection

DISPERSION/DIV.	IF Bandwidth (3 dB)	Average Noise Level
100 MHz 50 MHz	300 kHz	20 dBμV
20 MHz 10 MHz 5 MHz	100 kHz	15 dBμV
2 MHz 1 MHz 0.5 MHz	30 kHz	30 dBμV
0.2 MHz 0.1 MHz	10 kHz	5 dBμV
ZERO	300 kHz	20 dBμV

3.5.3 SPECTRUM ANALYSIS

Always perform the Amplitude Level Calibration procedure (Section 3.4.2.1), before proceeding with spectrum analysis of an input signal spectrum.

NOTE: Never utilize the mirror image of the signal spectrum which appears on the left side of the zero frequency trace for measurement purposes since they are not accurately displayed.

3.5.3.1 Apply the unknown signal to the INPUT of the unit, with the DISPERSION/DIV. switch set to the 100 MHz/DIV. position and the RF AT-

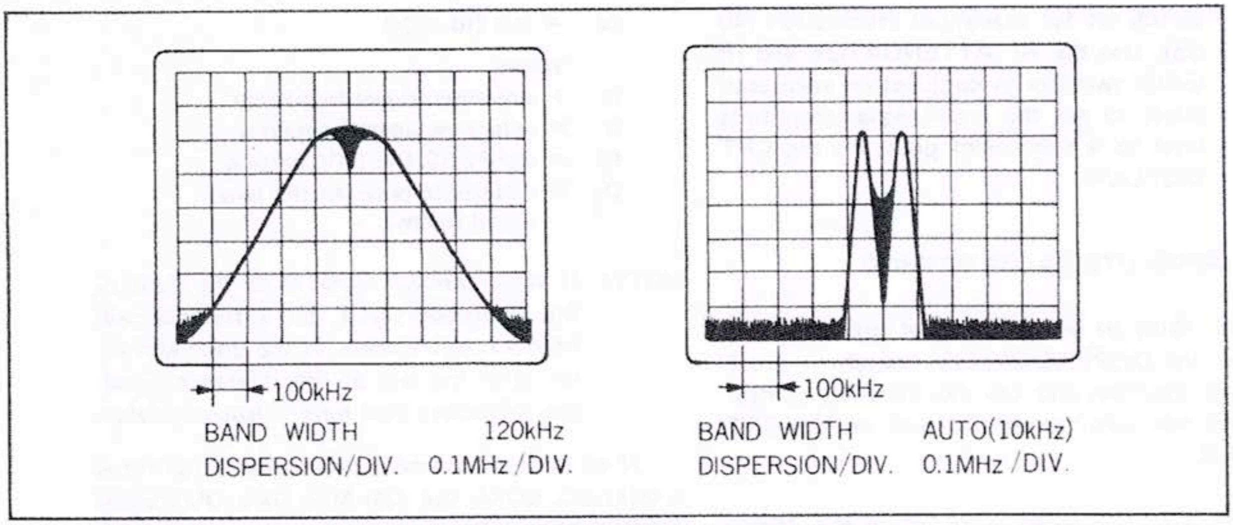


Figure 3.14 Separation of Signals of Same Amplitude

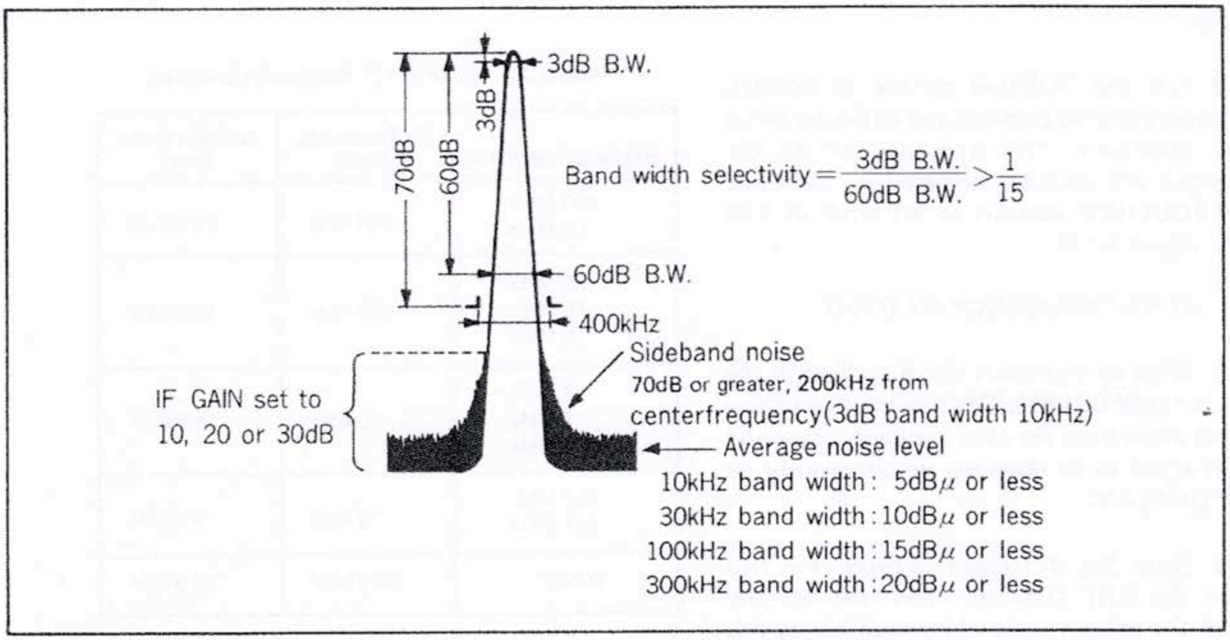

3dB B.W.
3dB
70dB
60dB
Band width selectivity = 3dB B.W. / 60dB B.W. > 1/15
60dB B.W.
400kHz
Sideband noise
70dB or greater, 200kHz from
centerfrequency(3dB band width 10kHz)
Average noise level
10kHz band width: 5dBμ or less
30kHz band width: 10dBμ or less
100kHz band width: 15dBμ or less
300kHz band width: 20dBμ or less
IF GAIN set to
10, 20 or 30dB

Figure 3.15 Separation of Signals of Different Amplitude

TENUATOR set at the 40 dB position. In combination with the TUNING control, set the RF ATTENUATOR and DISPERSION/DIV. switches so that the signal spectrum remains at the center of and at a convenient level on the CRT DISPLAY.

NOTE: Avoid utilizing the 0 dB position of the RF ATTENUATOR switch due to impedance mismatching, especially at higher input levels and frequencies.

3.5.3.2 For spectrum analysis the BANDWIDTH switch is normally set to the AUTO position, with the 3 dB IF bandwidth being automatically selected in conjunction with the DISPERSION/DIV. switch settings as shown in Table 3.3. The average noise level shown, which depends upon the IF bandwidth, is with the VIDEO FILTER switch set to the 100 Hz position. When measuring a low level signal, set the DISPERSION/DIV. switch to a smaller division setting which in turn will select a narrower IF bandwidth.

3.5.3.3 The BANDWIDTH setting determines the frequency resolution by reason of the IF bandwidth chosen. If the bandwidth is 10 kHz for instance, signal measurements will not be possible unless the difference between two signals is more than 10 kHz (see Figure 3.14). In addition the time constant becomes longer as the IF bandwidth is made narrower, thus either the scan rate must be set to a slower speed or the DISPERSION/DIV. switch set to a smaller division setting for the same bandwidth. Because of this the instrument is designed to have the optimum 3 dB IF bandwidth automatically selected for the position of the DISPERSION/DIV. switch chosen whenever the BANDWIDTH switch is set to the AUTO position. It also permits, for the conditions stated, measurements to be made at the maximum scan rate of 20 milliseconds for all dispersion/bandwidth conditions. However, when the 6 dB bandwidth is utilized, the bandwidth is not selected automatically for the DISPERSION/DIV. switch position chosen. Thus the level of the signal spectrum may decrease as the IF bandwidth is made narrower and the dispersion per division made wider. In this instance, the scan time must be selected for the optimum signal level.

In addition to its bandwidth, the selectivity of an IF filter also determines what the frequency resolution will be. The selectivity of an IF filter is specified as the ratio of the 60 dB bandwidth to the 3 dB/6 dB bandwidth. The bandwidth selectivity of the ESA-1000 is 15 to 1, thus a frequency difference equal to 7.5 times the 60 dB IF bandwidth or greater is necessary to completely separate two signals with an amplitude difference of 60 dB. In conclusion, good selectivity indicates excellent ability to discriminate between signals of different amplitude levels (see Figure 3.15).

3.5.3.4 In addition to IF bandwidth selectivity, sideband noise also affects the unit's ability to separate signals of different amplitude levels and adjacent frequencies. Sideband noise is the noise which appears on the skirts of an IF filter as shown in Figure 3.15 and influences the unit's frequency resolution when observing signals of different amplitude levels. The sideband noise of the ESA-1000 is specified as being 70 dB or more below the peak of a carrier signal at 200 kHz away from the center of the carrier for a 3 dB IF bandwidth of 10 kHz.

3.5.3.5 The 100 Hz or 10 kHz VIDEO FILTER, which is utilized in conjunction with the MEAN (AVERAGE) portion of the DETECTION MODE switch, are low pass filters which are inserted into the circuit driving the CRT DISPLAY. The low pass filters average the internal noise of the unit which permits observation of a signal waveform located on or near a IF filter skirt or by cleaning up the bottom portion of a signal waveform increases the degree of resolution. Effective averaging occurs whenever the bandwidth of the loww pass filter being utilized is held to 1/30 or less of the selected IF bandwidth circuit. When activated the amplitude level of the signal spectrum may decrease due to the time constant of the low pass filter. In this case, either set the SCAN MODE switch to the MANUAL position or use the SCAN TIME control to set the sweep speed to a slower rate. This will improve the signal/noise ratio by approximately 10 dB as shown in Figure 3.16.

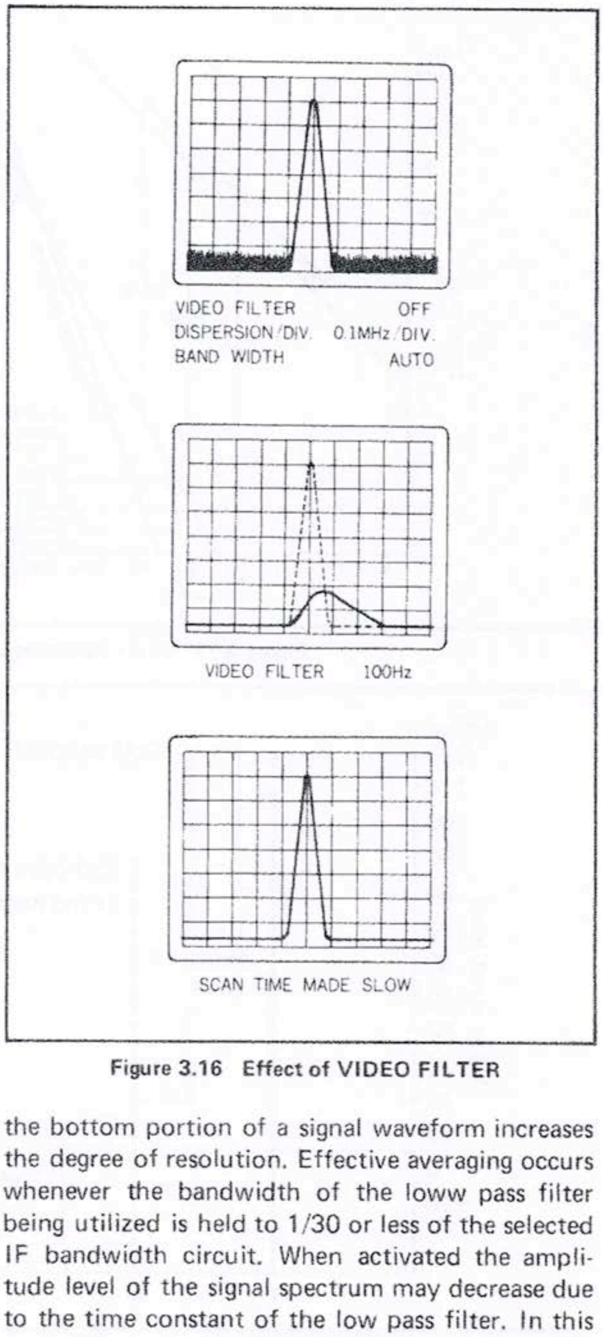
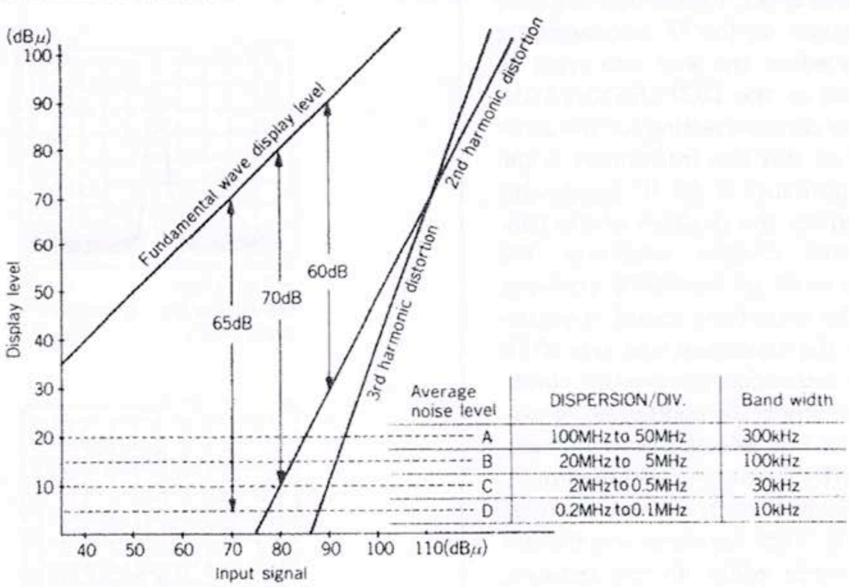


Figure 3.16 Effect of VIDEO FILTER

3.5.4 HARMONIC DISTORTION MEASUREMENT

3.5.4.1 Harmonic distortion is measured in the same manner as the amplitude level measurements described in Section 3.5.1 (Level Measurement)



Average noise level	DISPERSION/DIV.	Band width
A	100MHz to 50MHz	300kHz
B	20MHz to 5MHz	100kHz
C	2MHz to 0.5MHz	30kHz
D	0.2MHz to 0.1MHz	10kHz

Figure 3.17 Mixer Harmonic Distortion Noise

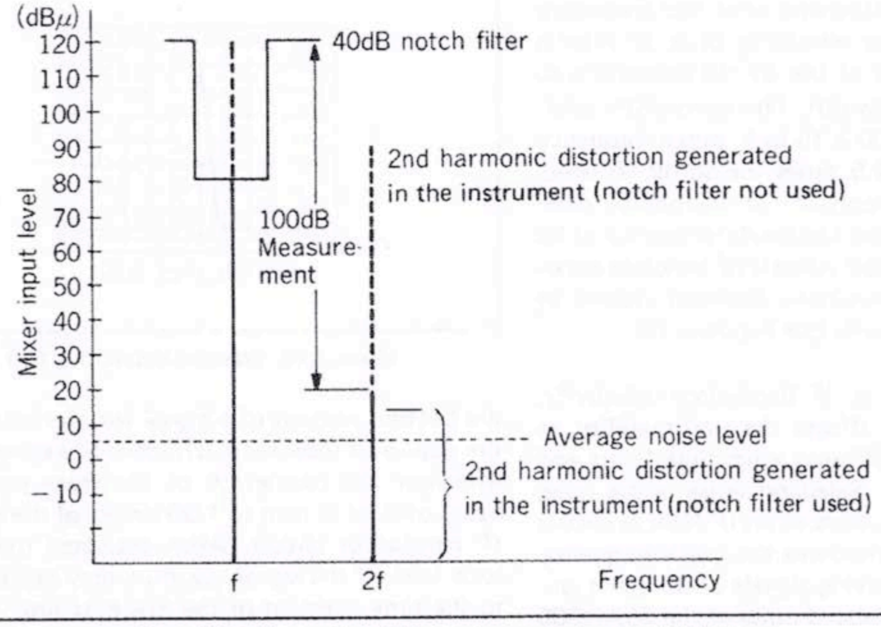


Figure 3.18 Expansion of Dynamic range using a notch filter

and the frequency measurements described in Section 3.5.2 (Frequency Measurement). However in making harmonic distortion measurements, special consideration must be given to the harmonics generated by the 1st MIXER stage of the instrument.

3.5.4.2 Referring to Figure 3.17: if an 80 dBuV level input signal is applied to the unit's 1st MIXER stage, the second harmonic generated by the mixer will be at a level of 10 dBuV or 70 dB down from the fundamental input signal level. If the fundamental input level is increased by 10 dB the second harmonic level will increase by 20 dB. Thus to accurately measure the second harmonic of an input signal which is 60 dB below the input fundamental level, the RF ATTENUATOR (located in before the 1st MIXER stage) must be adjusted to set the input level into the mixer at between 70 and 90 dBuV. As a guide, the input levels at which the instrument will accurately measure a second harmonic level that is 70 dB below the fundamental level is indicated as the NON-DISTORTION INPUT LEVEL (dBuV) located above the RF ATTENUATOR control markings on the front panel.

3.5.4.3 When measuring low level distortion signals, the use of a rejection/notch filter for the fundamental signal is recommended. By inserting the filter between the unknown signal and the unit's INPUT, the dynamic range of the unit is increased along with a corresponding increase in the distortion measurement capability (see Figure 3.18). For example, if a fundamental signal at a level of 120 dBuV and with a second harmonic 100 dB down (20 dBuV) is applied via a 40 dB notch filter to the instrument's INPUT the input level of the fundamental is reduced to 80 dBuV. By decreasing the fundamental input level, the level to the 1st MIXER stage is reduced (and thus decreasing the second harmonic outputs generated by the mixer) permitting accurate measurements of second harmonics down 70 dB from the fundamental level. Thus a second harmonic, with a 20 dBuV level, can be accurately measured since the fundamental level is at 80 dBuV instead of 120 dBuV.

3.5.5 FIELD STRENGTH MEASUREMENT

When the REFERENCE LEVEL selector switch is set to either the ANTENNA A or ANTENNA B positions, the CRT DISPLAY reference level (top horizontal line) as indicated by the REFERENCE LEVEL readout will be in terms of dBuV/M. The electric field strength is read directly from the CRT DISPLAY, since the REFERENCE LEVEL display indication includes the appropriate antenna factors for the particular antennas being used. The ANTENNA A position is for a tuned dipole antenna, while the ANTENNA B position is for a log periodic antenna. The antenna factors for the antenna types noted includes losses in the CAL-25 connecting cable (25 FT. RG-55). If another cable type and length is substituted by the operator, its losses will have to be compared with those of the CAL-25 and suitable corrections made to the level readings.

3.5.5.1 Before proceeding with the field strength measurements, calibrate the instrument for amplitude level and frequency accuracy. Use the amplitude level calibration procedure of Section 3.4.2.1 and the frequency calibration procedure of Section 3.5.2.1.1 through 3.5.2.1.3.

3.5.5.2 Connect the selected antenna to the instrument's INPUT and set the REFERENCE LEVEL selector switch to the ANTENNA A or B position depending on the antenna type used.

3.5.5.3 Use the DISPERSION/DIV. switch to adjust the signal spectrum display for the desired degree of accuracy and signal clarification. The TUNING control is used to center the selected signal at the center of the CRT DISPLAY.

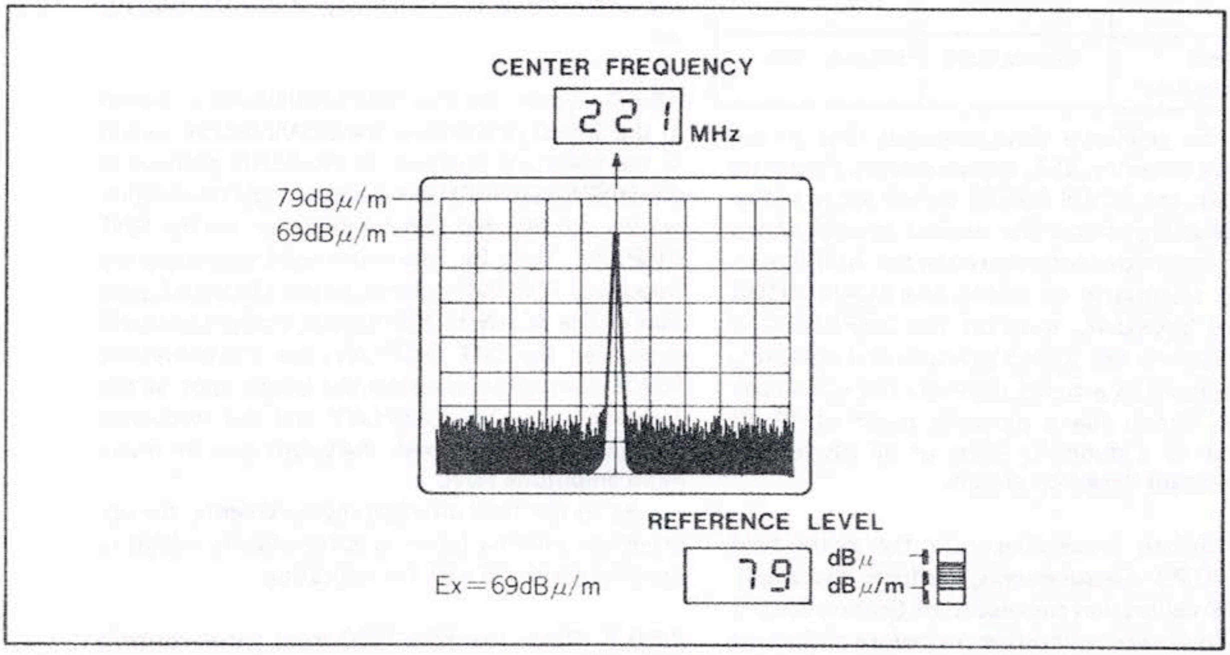


Figure 3.19 Field Strength display

3.5.5.4 The amplitude level of the selected signal is read directly from the CRT DISPLAY in terms of dBuV/M (see Figure 3.19). Since the reference level reading includes the correct antenna (for the antenna utilized) for the selected center frequency, no additional correction factors are normally needed.

3.5.5.5 In those instances where a different type of antenna is utilized, set the REFERENCE LEVEL selector switch to the INPUT LEVEL (dBuV) position. Add the antenna factor for the selected antenna to the amplitude level reading to obtain the correct level in terms of dBuV/M. In addition other correction factors, for example cable losses, may also need to be added to the indicated reading.

3.5.6 Noise Field Strength (Quasi-Peak Value) Measurement utilizing Dipole Antenna.

When the ESA-1000 DETECTION MODE switch is set to the Q.P. position and the 6 dB IF bandwidth switch set to either the 9 kHz or 120 kHz position, the amplitude level measurements will be to CISPR quasi-peak specifications and standards. See Table 3.4 for CISPR time constants, bandwidths, and frequencies.

TABLE 3.4 CISPR Time Constants and Bandwidths

Frequency Range	150 kHz to 30 MHz	25 MHz to 1000 MHz
6 dB Bandwidth	9 kHz	120 kHz
Q.P. Detector Charge Time	1 msec ± 20%	1 msec ± 20%
Q.P. Detector Discharge Time	160 msec ± 20%	550 msec ± 20%

Due to the relatively slow response time of the quasi-peak circuitry, Q.P. measurements should be taken with the SCAN MODE switch set to either the MANUAL position (for manual control of the scan) or for a slow sweep speed in the AUTO position. An alternative to setting the SCAN MODE switch to MANUAL, is to set the DISPERSION/DIV. switch to the ZERO position and operating the instrument as a tuned receiver. The quasi-peak detection circuit has a dynamic range of 40 dB compared to a dynamic range of 80 dB for the average (mean) detection circuit.

3.5.6.1 Before proceeding with the noise field strenth (Q.P.) measurements, perform the amplitude level calibration procedure of Section 3.4.2.1 and the frequency calibration procedure of Section 3.5.2.1.1 through 3.5.2.1.3.

3.5.6.2. Set the ESA-1000 front panel controls as follows:

RF. ATT.	40 dB
IF GAIN	0 dB
DISPERSION/DIV.	100 MHz/DIV.
B.W. (Hz) 6 dB	1.5 MHz (6 dB)
TUNING/PRESET	TUNING
DETECTION MODE	MEAN (VIDEO FILTER-OFF)
SCAN MODE	AUTO
REFERENCE LEVEL	ANTENNA-A
VERTICAL AXIS SCALE SELECTOR	10 dB/DIV.

3.5.6.3 Connect the dipole antenna to the INPUT of the instrument, a broad signal spectrum should appear on the CRT DISPLAY. Adjust the RF ATTENUATOR to set the peak of the spectrum display at a point not to exceed 10 dB (1 division) below the reference point of the CRT graticule (to prevent mixer gain compression).

3.5.6.4 Next adjust the IF GAIN to set the spectrum peak at a point not to exceed the top horizontal reference line of the CRT graticule (to prevent overload of the IF section).

3.5.6.5 Use the TUNING control to center the unknown signal to be measured at the center of the CRT DISPLAY. The CENTER FREQUENCY readout will indicate the frequency of the selected signal.

3.5.6.6 Either set the DISPERSION/DIV. switch to the ZERO position or the SCAN MODE switch to the MANUAl position. In the ZERO position of the DISPERSION/DIV. switch, a single trace representing the selected signal will appear on the CRT DISPLAY. Peak for maximum amplitude using the frequency TUNING control. In the MANUAL position of the SCAN MODE switch, a bright spot will appear on the CRT DISPLAY. Use the MANUAL SCAN control to position the bright spot at the center of the CRT DISPLAY and the frequency TUNING control to peak the bright spot for maximum amplitude level.

As in the field strength measurements, the appropriate antenna factor is automatically added to the REFERENCE LEVEL indication.

3.5.6.7 Reset the ESA-1000 front panel controls as follows:

B.W. (Hz) 6 dB . . . . .9 kHz or 120 kHz
(Selected according to frequency)
DETECTION MODE . . . . Q.P.
VERTICAL AXIS SCALE
SELECTOR . . . . 5 dB/DIV.

NOTE: Whenever the DETECTION MODE switch is set to the Q.P. position, the REFERENCE LEVEL indication will decrease by 40 dB since the gain is automatically increased by 40 dB within the instrument. Because of this, the CRT DISPLAY presentation may disappear under some measurement conditions. Readjust the RF ATTENUATION and IF GAIN to bring the presentation back onto the CRT.

3.5.6.8 The amplitude level displayed on the CRT is the noise field strength of the signal under measurement. The amplitude level is read as follows:

NOISE FIELD STRENGTH (dBuV/M) = REFERENCE LEVEL indication (dBuV/M) + CRT DISPLAY amplitude level different from Reference point (dB).

Therefore: If the REFERENCE LEVEL Indication = 79 dBuV/M, and the amplitude level on the CRT DISPLAY = 4 divisions down from the reference level or 4 DIV. X 5 dB/DIV. = - 20 dB

thus the NOISE FIELD STRENGTH = 79 dBuV/M + (- 20 dB) = 59 dBuV/M.

Figure 3.20 shows the CRT DISPLAY presentation when the DISPERSION/DIV. switch is set to the ZERO position. As noted above, only a bright spot appears when the SCAN MODE switch is set to the MANUAL position.

3.6 DM-1000 DIGITAL MEMORY OPTION

3.6.1 GENERAL

The DM-1000 Digital Memory accessory is a factory added option which allows the ESA-1000 Spectrum Analyzer to store the CRT spectrum presentation data in digital form. The memory unit contains two data storage channels: Channel A which continuously updates the CRT DISPLAY and Channel A/B which fixes the data in one channel for a static CRT display while the other channel continuously updates the CRT DISPLAY.

The DM-1000 enables the ESA-1000 to make accurate waveform measurements at the slower sweep rates required by certain measurement conditions. The single channel memory mode enables the input information to be acquired at the slower sweep rates, while the CRT display is continuously updated at a faster sweep rate. In addition when performing comparative measurements utilizing reference signals or making field strength measurements especially to CISPR specifications, the dual channel mode will enable accurate and precise measurements to be quickly accomplished.

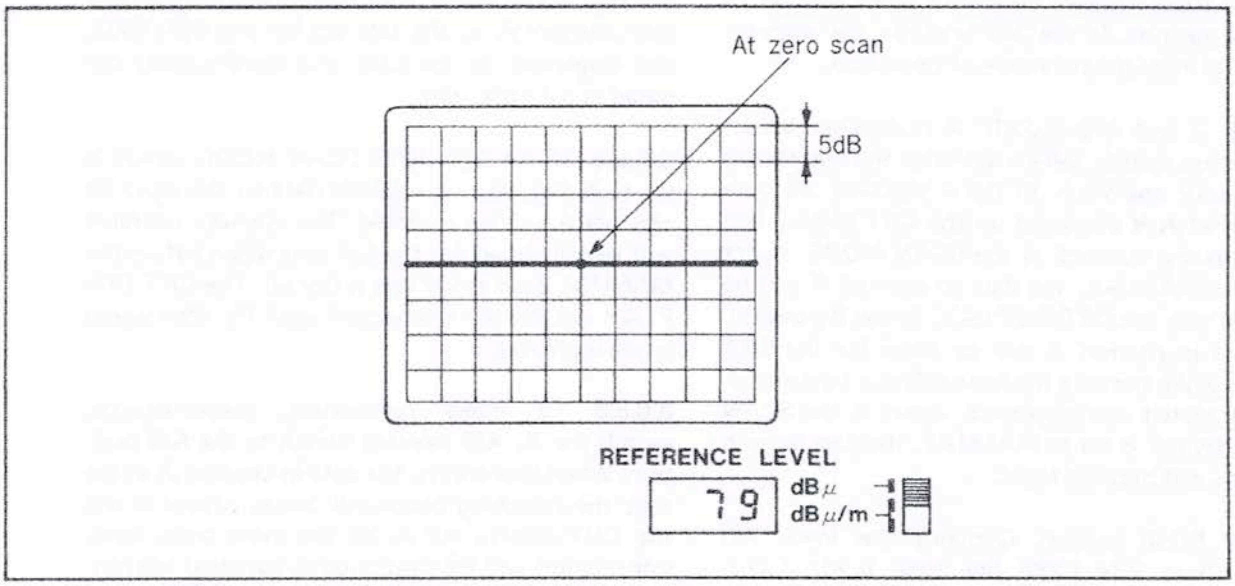


Figure 3.20 Noise Field Strength Measurement Procedure

3.6.2 DM-1000 SPECIFICATIONS

Memory:	X axis 9 bits, 512 points. Y axis 8 bits, 256 points.
Write time:	20 msec. to 10 sec. depending on the ESA-1000 SCAN MODE time setting.
Display time:	Approximately 4 msec., full-scale repetition.
Sampling Error:	Y axis 2.5% max.
Storage function:	Memory contents stored by setting the ESA-1000 SCAN MODE to MANUAL.
Display function:	A – display of data in memory channel A. A/B – display of data in memory channel A and B.
Operating temperature:	0°C to +40°C.
Power requirements:	All power required supplied by ESA-1000.
Power consumption:	Approximately 25 VA.
Warmup time:	Approximately 30 minutes.
Dimensions:	Approximately 11.4" (W) X 1.6" (H) X 15.3" (D) (290X40X390

3.6.3 DM-1000 PANEL CONTROLS
(See Figure 3.21)

3.6.3.1 MEMORY ON/OFF Switch: A maintained action pushbutton switch, which activates the DM-1000 memory functions when pushed to the ON position. In the OFF position, the analyzer functions in its normal mode of operation.

3.6.3.2 A and A/B Switch: A maintained action pushbutton switch, which activates the two modes of memory operation. In the A position, the data in channel A is displayed on the CRT display and continuously updated. If the SCAN MODE switch is set to MANUAL, the data in channel A will be fixed as will the CRT DISPLAY. In the B position, the data in channel A will be fixed for the CRT display while the data in channel B will be continuously updated and displayed. Again if the SCAN MODE switch is set to MANUAL, the data in both channels will become fixed.

3.6.3.3 FUSE holder: Contains the input AC power (from ESA-1000) line fuse: 0.20A (slow-blow).

3.6.4 PRELIMINARY PRECAUTIONS

3.6.4.1 Since the ESA-1000 and the DM-1000 are connected internally. It is recommended that the two units not be separated.

3.6.4.2 When the ESA-1000 SCAN MODE switch is set to the SINGLE position, only the normal sweep operation will be performed, the normal sequence of single sweep functioning is performed for making another sweep.

3.6.5 OPERATING PROCEDURE DM-1000

CAUTION

Before turning on the ESA-1000 Spectrum Analyzer, always set the A, A/B selector switch to the A position.

3.6.5.1 Set the DM-1000 front panel controls as follows:

MEMORY ON/OFF switch – OFF
A, A/B switch – A position

3.6.5.2 Place the ESA-1000 AC POWER switch to its ON position.

3.6.5.3 Place the MEMORY ON/OFF switch to the ON position. With the A, A/B switch in the A position, input signal information will be accepted into channel A at the rate set by the ESA-1000, but displayed on the CRT and continuously updated at a 4 msec. rate.

3.6.5.4 If the ESA-1000 SCAN MODE switch is set to MANUAL, no updated data to the input of channel A will be accepted. The memory contents will remain fixed for the last data input before the MANUAL scan mode was activated. The CRT DISPLAY will remain unchanged until the scan sweep mode is altered.

3.6.5.5 To make comparison measurements, switch the A, A/B selector switch to the A/B position. When this occurs, the data in channel A at the time the switching occurs will become fixed as will the CRT display for A. At the same time, input information will be continuously supplied to channel B to keep the CRT display for B updated.

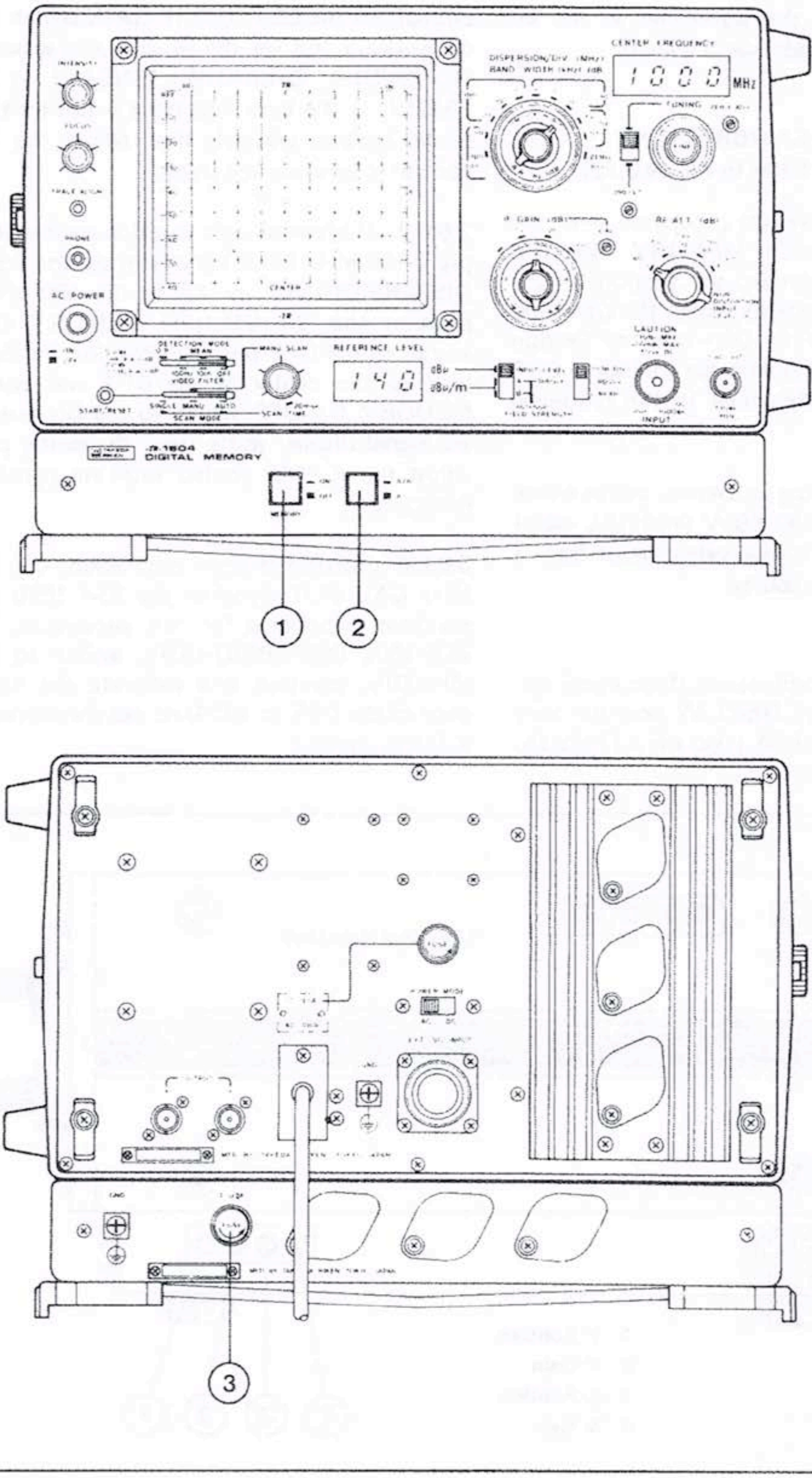

INTENSITY
FOCUS
TRACE ALIGN
PHONE
AC POWER
CENTER
DISPERSION/DIV (MHz)
BAND WIDTH (kHz) 3dB
CENTER FREQUENCY
1000 MHz
TUNING
ZERO ADJ
IF GAIN (dB)
RF ATT (dB)
CAUTION
DETECTION MODE
MEAN
VIDEO FILTER
MANU SCAN
START/RESET
SINGLE MANU AUTO
SCAN MODE
SCAN TIME
REFERENCE LEVEL
140
dBμ
dBμ/m
FIELD STRENGTH
INPUT
DIGITAL MEMORY
MEMORY
ON
OFF
FUSE
POWER MODE
GND
1
2
3

Figure 3.21 DM-1000 Front and Rear Panel

3.6.5.6 If, as in Section 3.6.5.4, the ESA-1000 SCAN MODE switch is set to the MANUAL position without changing the other control positions, the A/B channel data contents will become fixed. The CRT will display the waveforms at the instance the MANUAL mode was activated.

3.6.6 CRT DISPLAY CALIBRATION PROCEDURE (Refer to Figure 3.22)

For the CRT calibration procedure with the DM-1000 Memory unit's MEMORY ON/OFF switch in the OFF position, see Section 3.4.2.2 (CRT DISPLAY Calibration). When the DM-1000 is activated (MEMORY to ON) refer to Section 3.4.2.2 before proceeding with the additional CRT calibration procedure described in the following section.

NOTE: For the following procedure, utilize either the 100 MHz, 80 dBuV level CAL signal of the unit or an equivalent input from a signal reference source.

3.6.6.1 Vertical scale calibration: If the signal amplitude level on the CRT DISPLAY does not vary by 10 dB whenever the ESA-1000 RF ATTENUATOR, IF GAIN, or input signal level is changed by 10 dB, adjust the Y GAIN control.

3.6.6.2 Base line calibration: (NO input signal required) Set the ESA-1000 IF GAIN switch to the 0 dB position and set the vertical axis select switch (10 dB/DIV., 5 dB/DIV., LINEAR) to the 10 dB/DIV. If the base line trace is not on the horizontal bottom graticule line, adjust the Y POSI control to position the trace.

3.6.6.3 Horizontal axis position calibration: Apply a 100 MHz input signal and set the ESA-1000 DISPERSION/DIV. switch to the 100 MHz/DIV. position and the DM-1000 MEMORY ON/OFF switch to the OFF position. Position the signal display to the center of the CRT and switch the MEMORY ON/OFF switch to the ON position. If the signal display shifts from the center position, adjust the X POSI control until no signal shift is detected.

3.6.6.4 Horizontal scale calibration: Use the 100 MHz CAL OUT signal of the ESA-1000 and the resultant harmonics for this procedure. Set the ESA-1000 DISPERSION/DIV. switch to the 100 MHz/DIV. position and calibrate the horizontal scale of the CRT to 100 MHz per division using the X GAIN control.

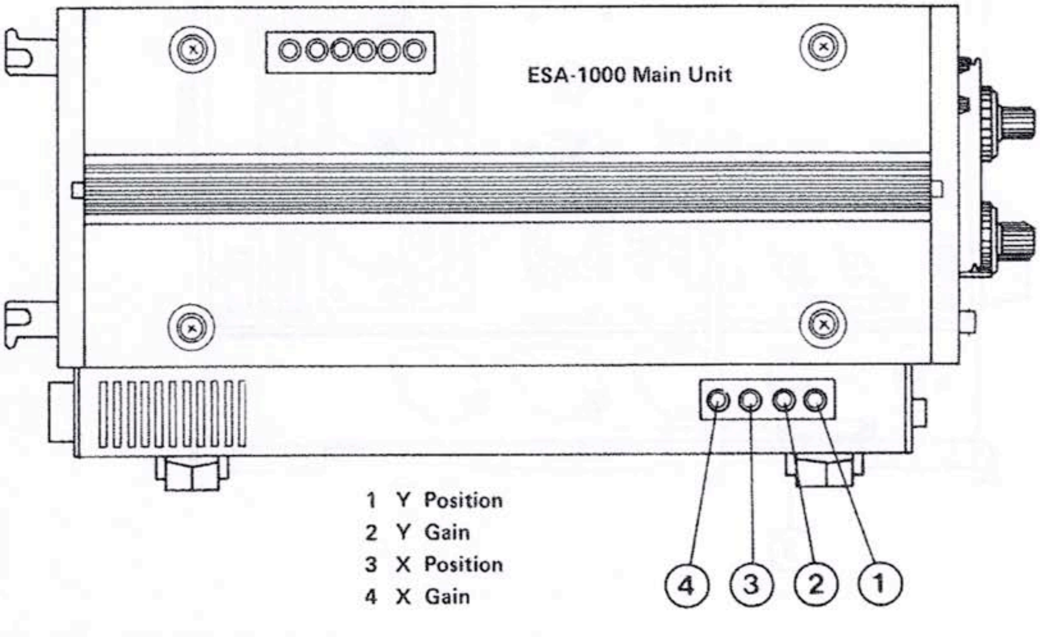


Figure 3.22 CRT Display CAL Adjustments (DM-1000)

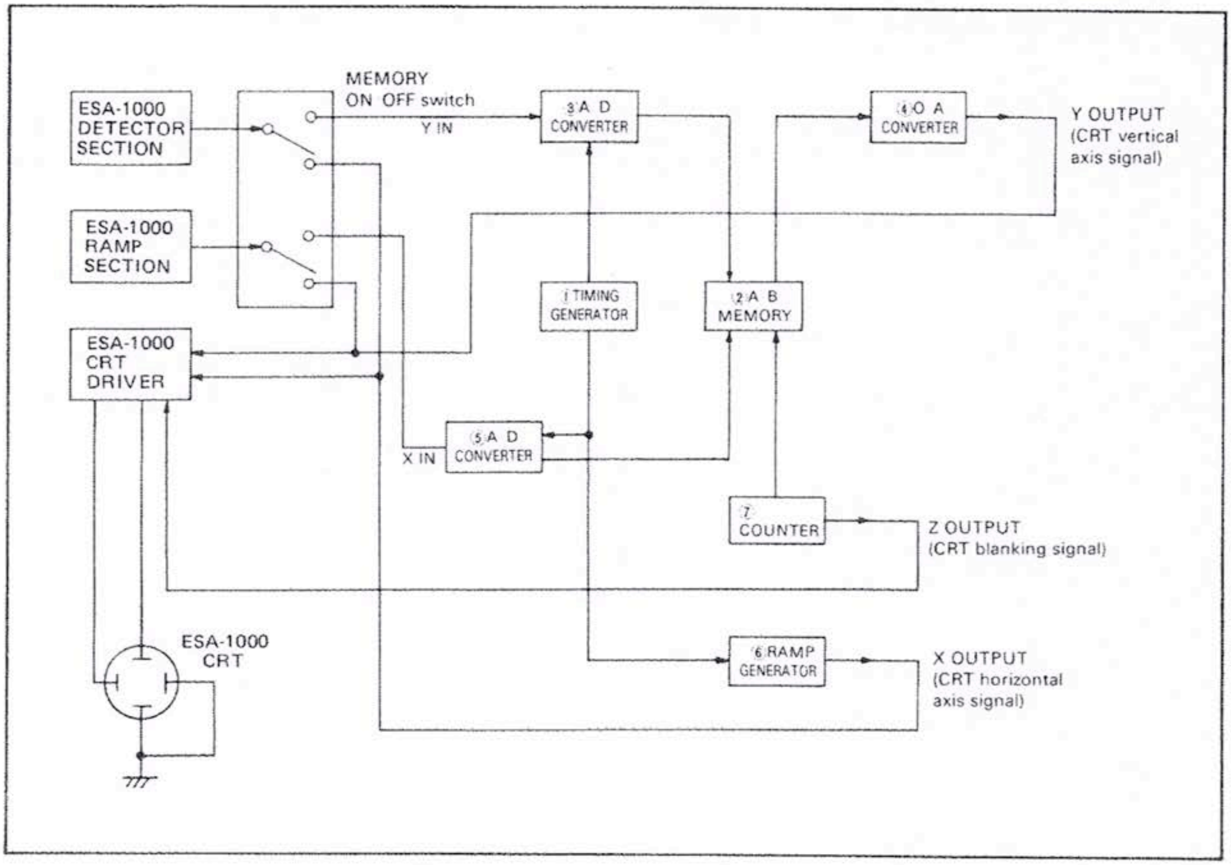

ESA-1000
DETECTOR
SECTION
ESA-1000
RAMP
SECTION
ESA-1000
CRT
DRIVER
MEMORY
ON OFF switch
Y IN
③A D
CONVERTER
④D A
CONVERTER
Y OUTPUT
(CRT vertical
axis signal)
①TIMING
GENERATOR
②A B
MEMORY
⑤A D
CONVERTER
X IN
⑦
COUNTER
Z OUTPUT
(CRT blanking signal)
ESA-1000
CRT
⑥RAMP
GENERATOR
X OUTPUT
(CRT horizontal
axis signal)

Figure 3.23 DM-1000 Block Diagram

3.6.7 DM-1000 BLOCK DIAGRAM

1. Timing generator: Generates the timing signals for control of the various memory unit stages.
2. A and B memory: Includes two pages composed of 256 points on the vertical axis and 512 points on the horizontal axis per page.
3. A/D converter (Y stage): Samples the vertical axis analog signals and converts them to digital forms.
4. D/A converter: Converts the vertical axis data stored in digital form in the memory to an analog signal and applies it to the vertical axis of the CRT.
5. A/D converter (X stage): Converts the horizontal analog signals to digital forms.
6. Ramp generator: Generates the approximately 4 msec. rampurances for which are applied to the input of the horizontal axis of the CRT.
7. Counter: Digital counter for the memory section (counts from 1 to 512) and supplies the blanking signal to the CRT.

SECTION IV
Performance Check

4.1 GENERAL

The performance tests listed in this section are designed to give specific information on the operational status of the instrument. The results of these tests will indicate whether the ESA-1000 is performing within specification limits and whether repair or recalibration is required. The following test procedures should be performed as part of the incoming inspection check and the results recorded for future reference as a standard for maintenance level testing and troubleshooting.

Table 4.1 lists the recommended test equipment and its performance ratings. (NOTE: Any equivalent test equipment with similar ratings can also be substituted).

4.2 WHEN TO UTILIZE TEST PROCEDURES

The performance test procedures should be used as follows:

a. As part of the incoming inspection check, with the results recorded for future reference.

b. As part of the periodic maintenance/calibration test check after every 500 hours of use.

c. As part of the repair procedure to locate malfunctioning circuits.

4.3 PRELIMINARY PRECAUTIONS

4.3.1 Always follow the operational precautions of Section 3.2 (Operational Precautions).

4.3.2 If the instrument has the optional DM-1000 Digital Memory unit, set the MEMORY ON/OFF to OFF and the A, A/B switch to A before AC power activation.

4.4 PERFORMANCE TEST PROCEDURES

TABLE 4.1 Recommended Test Equipment

Equipment	Performance Ratings	Recommendation
Signal Generator	Frequency: 1 MHz to 500 MHz Output level: 117 dBμ (50 Ω) Output impedance: 50 Ω Output level flatness: Within ± 0.5 dB Frequency accuracy: Within ± 1% Noise sideband: - 140 dB away from 200 Hz carrier	Hewlett Packard 8640B
Frequency Counter	Frequency: 10 Hz to 100 MHz Sensitivity: 10 mVrms Stability: 5×10^{-8}/day	
High Frequency Power Meter	Frequency: 100 kHz to 1500 MHz Sensitivity: - 30 dBm to +20 dBm Accuracy: ± 0.5 dB	Hewlett Packard 435B with 8484A Power Senser
Attenuator	Frequency: DC to 500 MHz Attenuation: 0 to 80 dB on 10 dB step Accuracy: ± 1.5 dB	Hewlett Packard 355D

4.4.1 Follow the power up procedure of Section 3.4.1 (General Power Up Procedure) from 3.4.1.1 to 3.4.1.7. Allow a minimum warmup period of approximately 30 minutes before proceeding with the following test procedures.

4.4.2 Initial Control Settings

Set the ESA-1000 front panel controls as follows:

INTENSITY	Center
FOCUS	Center
SCAN MODE	AUTO
DETECTION MODE	MEAN (VIDEO FILTER OFF)
SCAN TIME (MANUAL SCAN)	20 ms
REFERENCE LEVEL	INPUT LEVEL
VERTICAL AXIS SCALE SELECTOR	10 dB/DIV.
IF GAIN (dB)	0 dB, CAL.
RF. ATT.	0 dB
DISPERSION/DIV.	100 MHz/DIV.
B.W. (Hz) 6 dB	AUTO
TUNING/PRESET	TUNING

4.4.3 CAL OUTPUT CHECK

4.4.3.1 CAL OUT – Frequency Accuracy.

Specification: 100 MHz ± 0.20 MHz
Equipment used: Frequency Counter

a. Set the ESA-1000 front panel controls as per Section 4.4.2
b. Connect the CAL OUT of the instrument to the input of the Frequency Counter.
c. Verify that the counter reading is between 99.8 MHz and 100.2 MHz.

4.4.3.2 CAL OUT – Level Accuracy.

Specification: -27 dBM ± 0.5 BM.
Equipment used: Power Meter

a. Set the ESA-1000 front panel controls as per Section 4.4.2.
b. Connect the CAL OUT of the instrument to the input of the Power Meter and measure the level of the calibration signal.
c. Verify that the Power Meter reading is between -26.5 dB and -27.5 dBm

4.4.4 CRT DISPLAY-LOG Scale Accuracy

Specification: 0–3 dB ± 1.0 dB
30 dB–60 dB ± 1.0 dB
60 dB–70 dB ± 2.0 dB
Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

DISPERSION/DIV.	0.2 MHz/DIV.
B.W. (6 dB)	120 kHz
CENTER FREQUENCY	100 MHz
IF GAIN	10 dB OUTER, +5 dB INNER

b. Set the Signal Generator output to 100 MHz at a level of 95 dBuV and the 10 dB Step Attenuator to 0 dB. Connect the Signal Generator output via the Step Attenuator to the RF INPUT of the instrument.
c. Utilize the inner section of the IF GAIN switch to adjust the peak of the signal to match the top horizontal line (See Figure 4.1).
d. Change the external attenuator in 10 dB steps from 0 dB to 70 dB, while resetting the outer section of the IF GAIN switch from the 10 dB to the 0 dB position. When the input signal has been attenuated by 60 dB to 70 dB, measurements will be simplified if either the sweep rate is made slower or the manual scan mode is selected.
e. Verify that the signal amplitude level changes 10 dB ± 1 dB for a 10 dB change by the external attenuator over the range 0 dB to 30 dB, 10 dB ± 1.5 dB over the range 40 dB to 70 dB, and 10 dB ± 2 dB over the range 70 dB to 80 dB.
f. Reset the external attenuator to the 0 dB position and the outer section of the IF GAIN switch to the 10 dB position. Set the Vertical Axis Scale Selector switch to the 5 dB/DIV. position.
g. Adjust the V. REF. control located on the left side of the instrument (see Figure 3.9) to set the peak of the signal to the top horizontal line.
h. Verify that the amplitude level error of the signal peak is within 0.2 divisions when the external attenuator is changed in 10 dB steps from 0 dB to 40 dB (Figure 4.2A).
i. Set the inner section of the IF GAIN switch to the CAL position. Change the external attenuator in 10 dB steps from 0 dB to 30 dB.

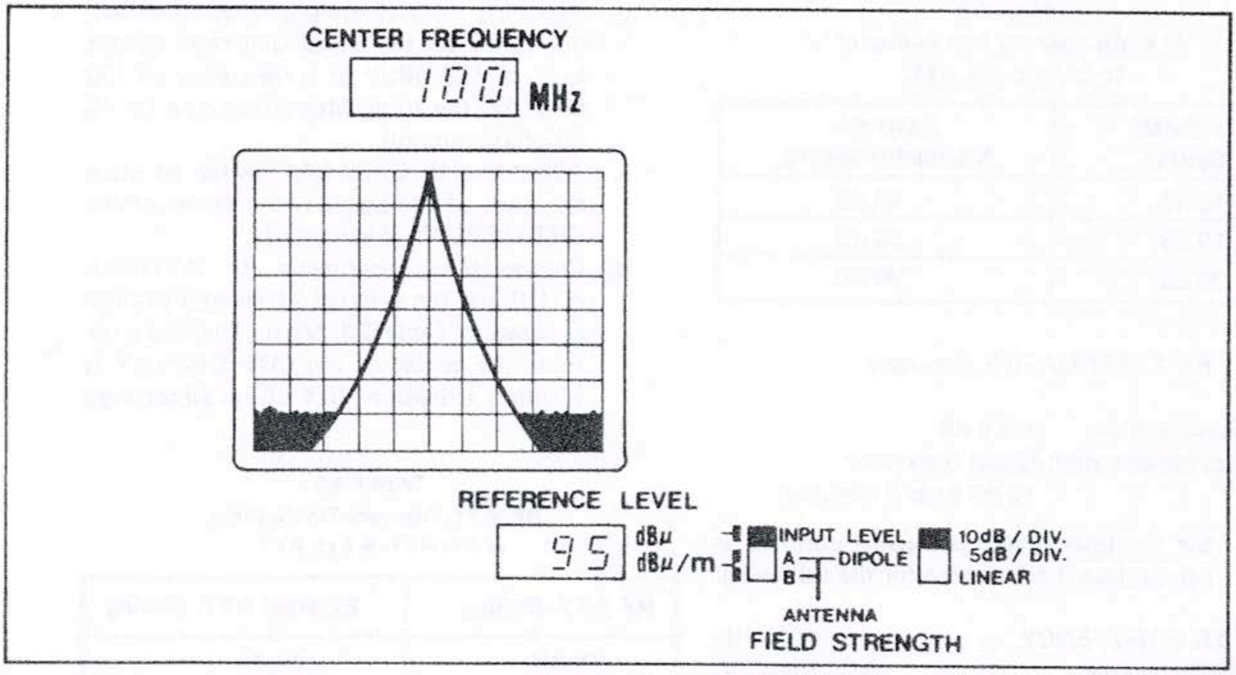

CENTER FREQUENCY
100
MHz
REFERENCE LEVEL
95
dBμ
dBμ/m
INPUT LEVEL
A
B
DIPOLE
ANTENNA
FIELD STRENGTH
10dB / DIV.
5dB / DIV.
LINEAR

Figure 4.1 CRT LOG. Scale Accuracy Check Procedure

j. Verify that amplitude level error is within 0.2 divisions for each 10 dB step (Figure 4.2B).

4.4.5 IF GAIN Accuracy

Specification:	± 0 dB
Equipment used:	Signal Generator 10 dB Step Attenuator

a. Set the ESA-1000 fron panel controls as Section 4.4.2 except for the following:

CENTER FREQUENCY	100 MHz
DISPERSION/DIV.	0.2 MHz/DIV.
B.W. (6 dB)	120 kHz
VERTICAL AXIS SCALE SELECTOR	5 dB/DIV.

b. Set the Signal Generator output to 100 MHz at a level of 95 dBuV and the 10 dB Step Attenuator to 0 dB. Connect the Signal Generator output via the Step Attenuator to the RF INPUT of the instrument.

c. Adjust the IF GAIN-CAL switch to place the peak of the signal at the center of the CRT DISPLAY (Figure 4.3).

d. Check that the level error of the signal peak from the graticule center is within 0.2 divisions (1 dB) for the combination settings of IF GAIN outer dial (0, 10, 20, 30 dB) and the Attenuator as follows:

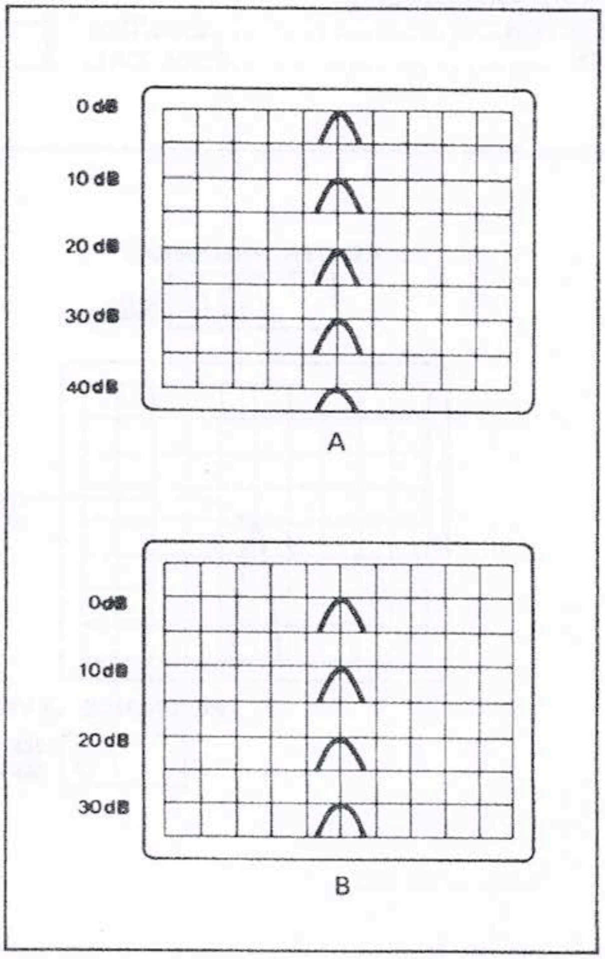

0 dB
10 dB
20 dB
30 dB
40 dB
A
0 dB
10 dB
20 dB
30 dB
B

Figure 4.2 A/B CRT LOG. Scale Error Display

TABLE 4.2
IF GAIN Accuracy Test Settings of
IF GAIN & Ext. ATT.

IF GAIN Setting	External Attenuator Setting
10 dB	10 dB
20 dB	20 dB
30 dB	30 dB

4.4.6 RF ATTENUATOR Accuracy

Specification: ± 0.5 dB
Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

CENTER FREQUENCY	100 MHz
DISPERSION/DIV	0.2 MHz/DIV.
B.W. (6 dB)	120 kHz
VERTICAL AXIS SCALE S SELECTOR	5 dB/DIV.
IF GAIN	20 dB, CAL.

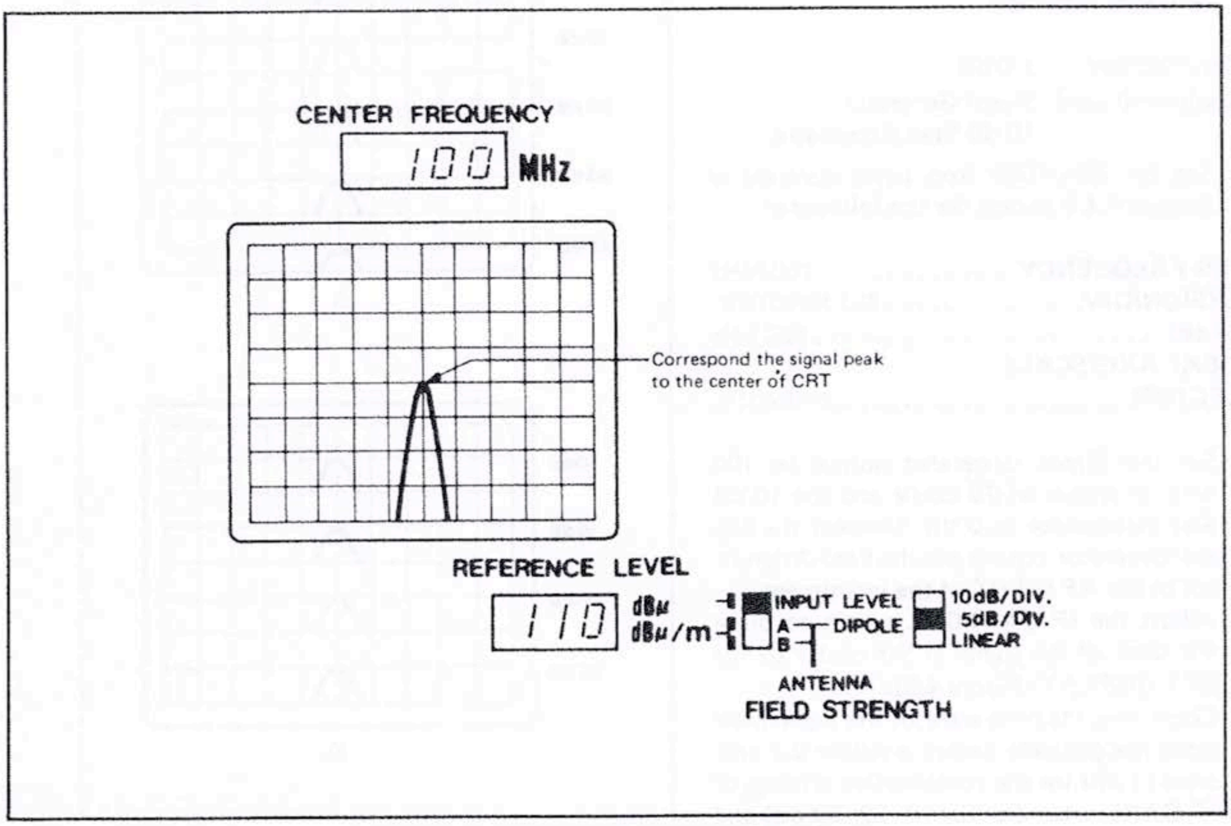
b. Retaining the test equipment setup of Section 4.4.5 set the Signal Generator output level to 110 dBuV at a frequency of 100 MHz. Set the 10 dB Step Attenuator for 40 dB of attenuation.

c. Adjust the IF GAIN-CAL switch to place the peak of the signal at the center of the CRT DISPLAY (Figure 4.4).

d. Change the instrument's RF ATTENUATOR and the external Attenuator settings as listed in Table 4.3. Verify that the error from the center of the CRT DISPLAY is within 0.1 divisions (0.5 dB) at all settings.

TABLE 4.3
RF. ATT. Accuracy Test/Settings
or RF. ATT. & Ext. ATT.

RF ATT. Setting	External ATT. Setting
10 dB	30 dB
20 dB	20 dB
30 dB	10 dB
40 dB	0 dB



Correspond the signal peak to the center of CRT

Figure 4.3 IF GAIN Accuracy Test Procedure

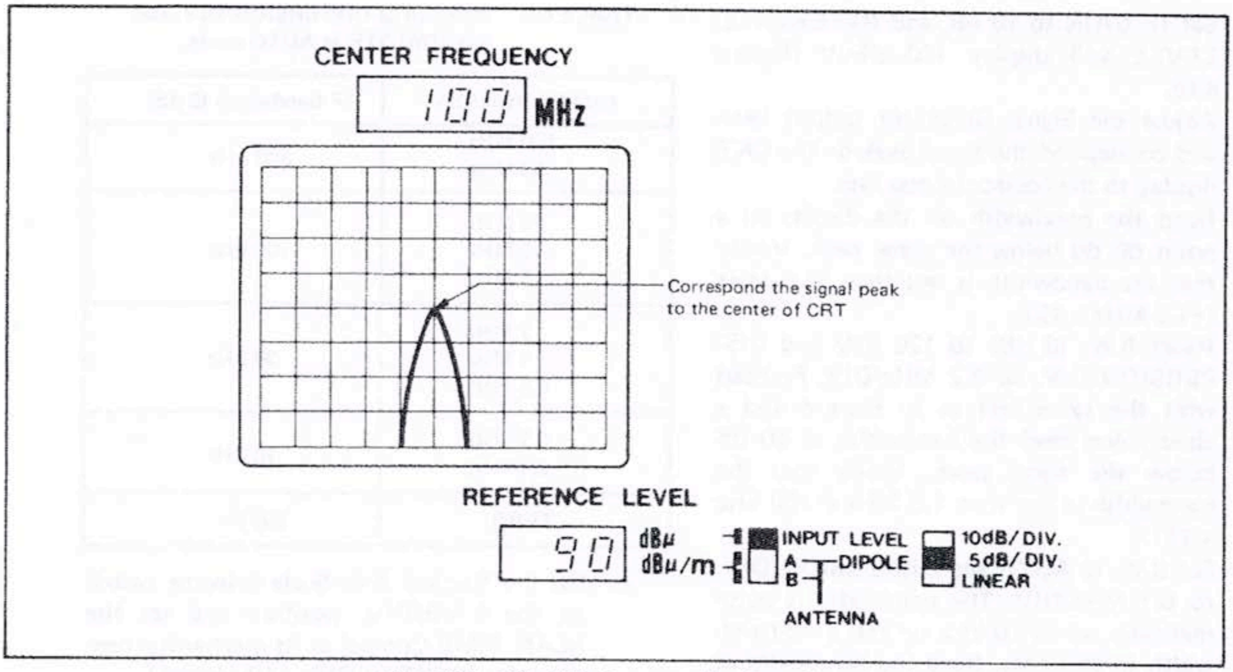

CENTER FREQUENCY
100 MHz
Correspond the signal peak to the center of CRT
REFERENCE LEVEL
90
dBμ
dBμ/m
INPUT LEVEL
A
DIPOLE
B
ANTENNA
10dB/DIV.
5dB/DIV.
LINEAR

Figure 4.4 RF. ATT. Accuracy Test Procedure

4.4.7 IF BANDWIDTH Accuracy

Specification: Within ± 20%
Equipment used: Signal Generator.

a. Set the ESA-1000 front panel controls as per Section 4.4.6a. The procedure will indicate when control setting changes are required.
b. Set the Signal Generator output level at approximately 96 dBuV with the frequency set at 100 MHz. Connect the output of the generator to the RF INPUT of the instrument.
c. Set B.W. (6 dB) to 1.5 MHz and DISPERSION/DIV., to 0.5 MHz/DIV. respectively. Set the Vertical Axis Scale Selector Switch to the 10 dB/DIV. position.
d. Adjust the Signal Generator output level so that the signal peak on the CRT display comes to 6 dB above the horizontal center (Figure 4.5).
e. Check that the frequency difference between two points where the signal crosses the horizontal center line is in the range from 1.2 MHz to 1.8 MHz.
f. Reset B.W. (6 dB) to 120 kHz and DISPERSION/DIV. to 0.1 MHz/DIV. Proceed the same test as in steps e and f above and check that the frequency difference is within 96 kHz to 144 kHz.

4.4.8 BANDWIDTH SELECTIVITY

Specification: 60 dB Bandwidth
Resolution/Bandwidth
Ratio 15:1.
Equipment used: Signal Generator

a. Set the ESA-1000 front panel controls as per Section 4.4.2. The procedure will indicate when control setting changes are required.
b. Retaining the same test setup as per Section 4.4.7, set the Signal Generator output level at approximately 100 dBuV at a frequency of 100 MHz.
c. Set B.W. (6 dB) to 1.5 MHz and DISPERSION/DIV. to 0.5 MHz/DIV.

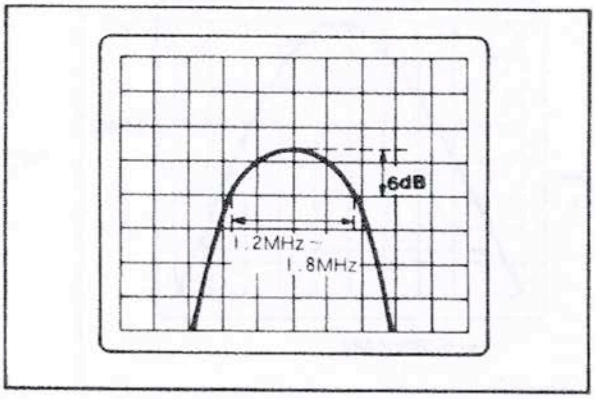

6dB
1.2MHz ~
1.8MHz

Figure 4.5 IF Bandwidth Accuracy Test Display

d. Set IF GAIN to 10 dB, and REFERENCE LEVEL will display 100 dBuV (Figure 4.6).
e. Adjust the Signal Generator output level and correspond the signal peak on the CRT display to the horizontal top line.
f. Read the bandwidth on the display at a point 60 dB below the signal peak. Verify that the bandwidth is less than 11.5 MHz (=1.5 MHz x 15).
g. Reset B.W. (6 dB) to 120 kHz and DISPERSION/DIV. to 0.2 MHz/DIV. Proceed with the same test as in steps d and e above, and read the bandwidth at 60 dB below the signal peak. Verify that the bandwidth is less than 1.8 MHz (=120 kHz x 15).
h. Set B.W. to AUTO and DISPERSION/DIV. to 0.1 MHz/DIV. The bandwidth is automatically set to 10 kHz on the 3 dB-bandwidth in this case. Read the bandwidth at 60 dB below the signal peak and verify that it is less than 150 kHz.

4.4.9 BANDWIDTH SWITCHING LEVEL ERROR

Specification: Within ± 1.0 dB
Equipment used: Signal Generator.

a. Set the ESA-1000 front panel controls as per Section 4.4.2. The procedure will indicate when control setting changes are required.
b. Retaining the same test setup as Section 4.4.8, set the Signal Generator output level at 90 dBuV at a frequency of 100 MHz.

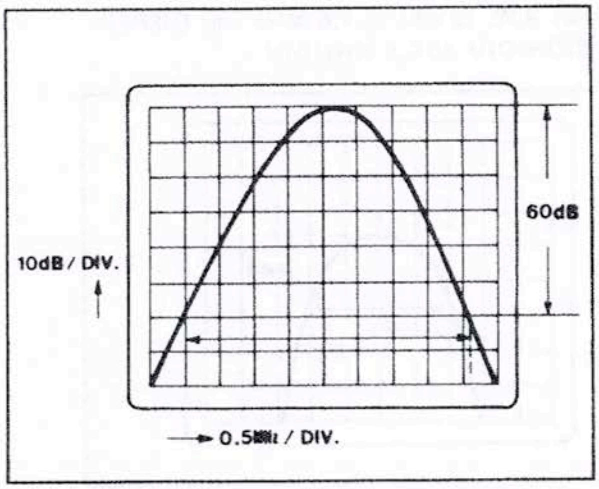


Figure 4.6 Bandwidth Selectivity Test Display

TABLE 4.4 Relation of DISPERSION/DIV. and BANDWIDTH in AUTO mode.

DISPERSION/DIV.	IF Bandwidth (3 dB)
100 MHz 50 MHz	300 kHz
20 MHz 10 MHz 5 MHz	100 kHz
2 MHz 1 MHz 0.5 MHz	30 kHz
0.2 MHz 0.1 MHz	10 kHz
ZERO	300 Hz

c. Set the Vertical Axis Scale Selector switch to the 5 dB/DIV. position and set the SCAN TIME Control at its mechanical center point (WHITE LINE – 12 o'clock).
d. As the DISPERSION/DIV. switch is switched clockwise, the 3 dB IF Bandwidth will change as per Table 4.4. The TUNING CONTROL is utilized to keep the signal centered on the CRT-DISPLAY.
e. Switch DISPERSION/DIV. from 100 MHz/DIV. to 0.1 MHz/DIV. in sequence and observe the signal level at each bandwidth. Then, keeping DISPERSION/DIV. at 0.1 MHz/DIV., switch B.W. counterclockwise in the sequence of AUTO – 9 kHz – 120 kHz – 1.5 MHz, and observe the signal level. Verify that the level difference between the highest and the lowest levels obtained during this procedure is within 1 dB (Figure 4.7).

4.4.10 FREQUENCY DISPLAY Accuracy

Specification: Within ± 10 MHz
Equipment used: Signal Generator and Frequency Counter.

NOTE: If the H.P. 8640B Signal Generator is utilized, the frequency can be read directly off the generator's frequency counter.

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

SCAN TIME	Mechanical Center
DISPERSION/DIV.	5 MHz/DIV.

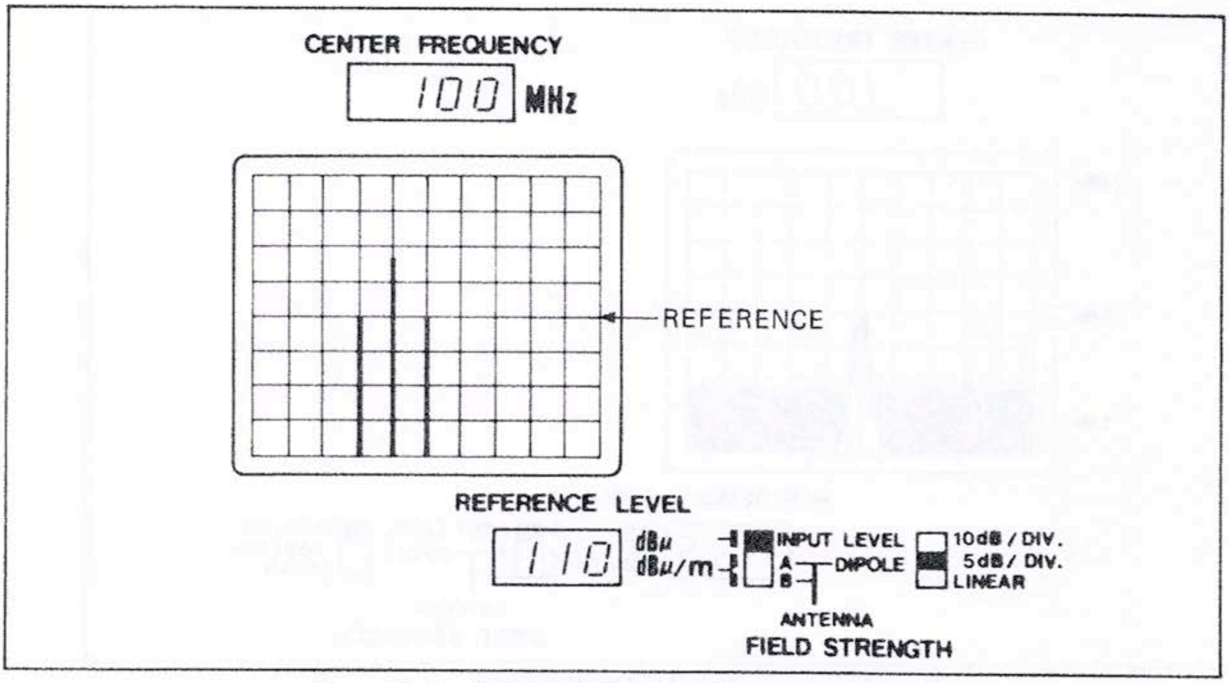


Figure 4.7 Bandwidth Switching Level Error Test Procedure

b. Retaining the same test setup as Section 4.4.9, set the Signal Generator output level at +120 dBuV and the output frequency at 100 MHz ± 50 MHz.

c. Adjust TUNING to center the zero frequency (Local feed through).

d. Reset DISPERSION/DIV. to 100 MHz/DIV. and return it to 5 MHz/DIV.

e. Adjust TUNING FINE to keep the zero frequency to the center.

f. Adjust ZERO ADJ. if necessary so that CENTER FREQUENCY indicates 000 MHz.

g. Turn TUNING to locate the 100 MHz signal and its harmonics one after the other to the center. Repeat the same procedure to the 10th harmonic, and read respective indication on CENTER FREQUENCY.

h. Verify that the indication error for 100xN (where N is the corresponding harmonic from 1st to 10th) is within ± 10 MHz.

i. Next, turn TUNING counter-clockwise and repeat the same procedure as in steps g and h above. Read the error and also verify that it is within ± 10 MHz.

4.4.11 FREQUENCY RESPONSE

Specification: <± 1.0 dB over the frequency range of 100 kHz to 1000 MHz.

Equipment used: Signal Generator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

CENTER FREQUENCY .... 500 MHz
VERTICAL AXIS SCALE
SELECTOR .... 5 dB/DIV.
IF GAIN .... 20 dB
RF. ATT. .... 0 dB
SCAN TIME .... Mechanical Center

b. The test set up is the same as utilized in Section 4.4.9. Set the Signal Generator output level at 80 dBuV and the output frequency at 100 MHz.

c. The resultant trace on the CRT DISPLAY, with the amplitude level established at the center horizontal line, will be used as the reference point.

d. Slowly tune the Signal Generator across the frequency range of 100 kHz to 1000 MHz, with the output level at 80 dBuV and the output frequency at 100 MHz.

e. The resultant trace on the CRT DISPLAY, with the amplitude level established at the center horizontal line, will be used as the reference point.

f. Slowly tune the Signal Generator across the frequency range of 100 kHz to 1000 MHz, with the output level fixed at 80 dBuV. Verify that the amplitude level remains within ±1.0 dB of the reference point across the entire frequency range.

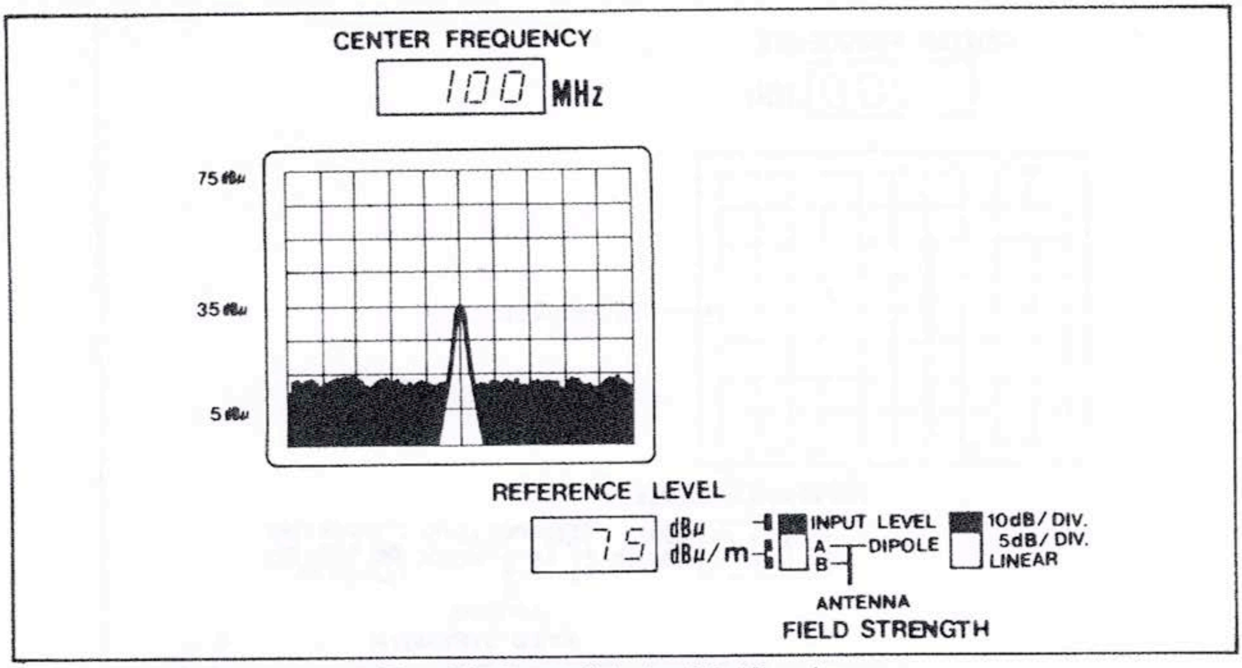

CENTER FREQUENCY
100 MHz
75 dBμ
35 dBμ
5 dBμ
REFERENCE LEVEL
75
dBμ
dBμ/m
INPUT LEVEL
A
B
DIPOLE
10dB/DIV.
5dB/DIV.
LINEAR
ANTENNA
FIELD STRENGTH

Figure 4.8 Average Noise Level Test Procedure

4.4.12 AVERAGE NOISE LEVEL

Specification: <5 dBuV with IF Bandwidth at 10 kHz, Video Filter at 100 Hz

Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

CENTER FREQUENCY	100 MHz
SCAN TIME	White-line at 12 o'clock
IF GAIN	30 dB, +5 dB
DISPERSION/DIV.	0.1 MHz/DIV.
B.W.	AUTO

b. Set the Signal Generator to a frequency of 100 MHz and an output level of 85 dBuV. Connect the output of the Signal Generator via the 10 dB Step Attenuator, set at 50 dB of Attenuation, to the input of the instrument.

c. Adjust the IF GAIN-CAL control to center the signal on the CRT DISPLAY (Figure 4.8).

d. Disconnect the Signal Generator input from the instrument and set the VIDEO FILTER to 100 Hz.

e. Set the SCAN TIME to a slower rate and verify that the average noise level is below 5 dBuV (Figure 4.9).

4.4.13 SPURIOUS RESPONSE

Specifcation: - 70 dB or less (RF ATTENUATOR 0 dB, input level 80 dBuV)

Equipment used: Signal Generator
Low Pass Filters, with cutoff frequencies of 10, 20, 30, 50, 70, 100, 150, 200, and 250 MHz respectively. Attenuation characteristics > 40 dB/octave.

a. Set the ESA-1000 front panel controls as per Section 4.4.2, except for the following:

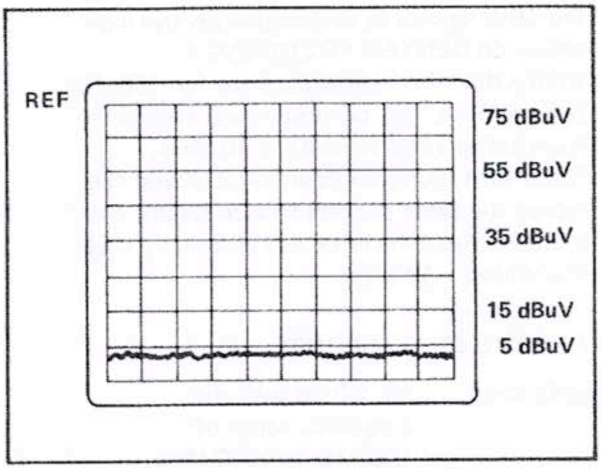

REF
75 dBuV
55 dBuV
35 dBuV
15 dBuV
5 dBuV

Figure 4.9 Average Noise Level Test Display

CENTER FREQUENCY . . . . .500 MHz
IF GAIN . . . . 10 dB

b. Set the Signal Generator frequency at 10 MHz and the output level at 100 dBuV. Connect the output of the generator, via the selected Low Pass Filter to the INPUT of the instrument.
c. Adjust the IF GAIN-CAL control to match the input signal level to the top horizontal line.
d. On the CRT DISPLAY, observe that the second harmonic of the signal is more than 50 dB below the fundamental signal (Figure 4.10).
e. Repeat the above procedure for the following frequencies: 20 MHz, 30 MHz, 50 MHz, 70 MHz, 100 MHz, 150 MHz, 200 MHz, and 250 MHz.

4.4.14 NOISE SIDEBAND

Specification: -70 dB Below signal level
(IF Bandwidth 10 kHz,
200 kHz away from carrier)
Equipment used: None

a. Set the ESA-1000 front panel controls as per Section
b. Set the DISPERSION/DIV. to 0.1 MHz/DIV. and center the zero frequency (local feedthrough) on the CRT DISPLAY using the TUNING control.
c. Use the IF GAIN-CAL control (outer and inner) to position the zero frequency peak to the horizontal line (Fig. 4.11).
d. Observe that the peak level of the noise is -70 dB or lower at a point 200 kHz away from the signal center.

4.4.15 FREQUENCY STABILITY

Specification: <200 kHz/5 minutes drift
Equipment used: Stop-Watch

a. Utilize same ESA-1000 control settings and procedure as Section 4.4.14.
b. Observe the zero frequency signal for 5 minutes after centering the signal and note that it is within ±2 divisions (±200 kHz) from the initial location.

4.4.16 RESIDUAL FM

Specification: Within 10 kHz P-P
Equipment used: None

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

SCAN TIME .White-line at 12 o'clock
DISPERSION/DIV . . . . 0.1 MHz/DIV.
B.W. (6 dB) . . . . .9 kHz

b. Use the IF GAIN-CAL control (inner and outer) to position the peak of the zero frequency signal at the top horizontal line (Figure 4.12A).

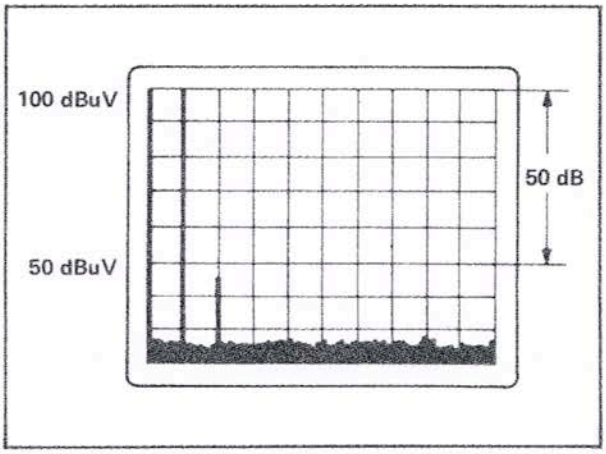


Figure 4.10 Spurious Response Test Display
(example: 100MHz signal)

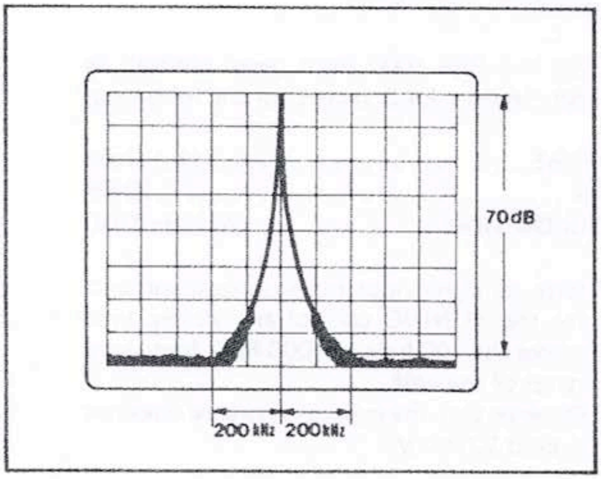


Figure 4.11 Noise Sideband Test Display

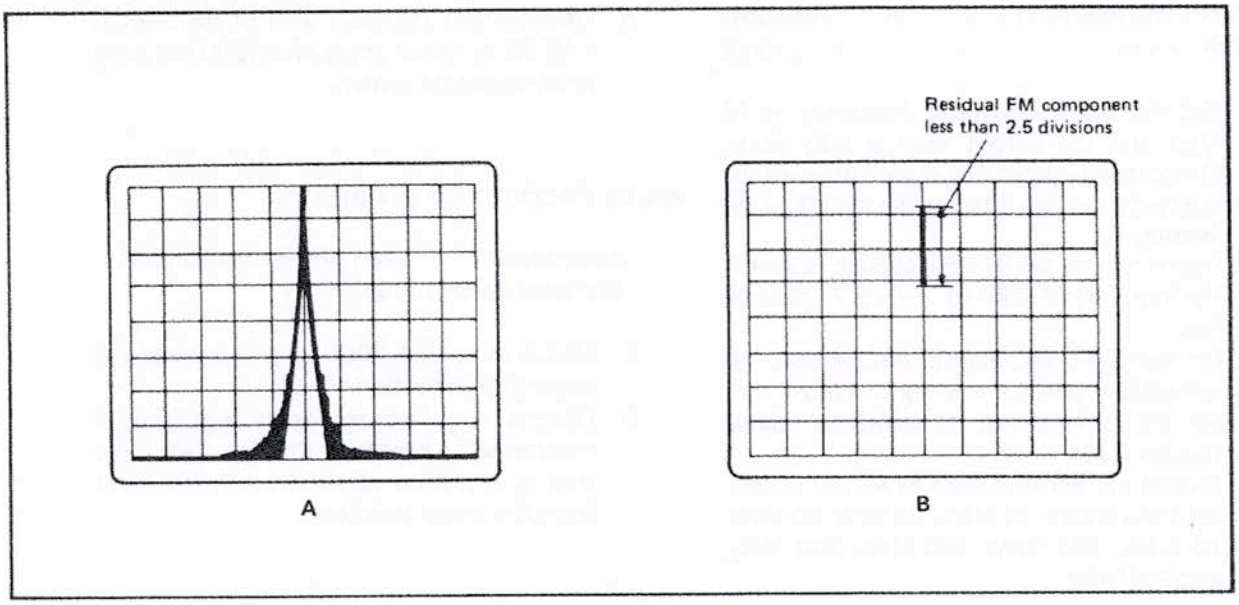


Figure 4.12 A/B Residual FM Test Display

c. Set the SCAN MODE switch to the MANUAL position and center the bright spot on the CRT DISPLAY by using the SCAN TIME control.

d. Position the bright dot to the second horizontal line from the top by using the TUNING (coarse and fine) control (Figure 4.12B).

e. Observe that the peak to peak width of the bright spot is less than 2.5 divisions.

4.4.17 RESIDUAL SPURIOUS RESPONSE

Specification: <20 dBuV (no input signal, RF ATTENUATOR 0 dB)
Equipment used: None

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

SCAN TIME .... 11 o'clock
IF GAIN .... 30 dB
DISPERSION/DIV. .... 20 MHz/DIV.

b. With no signalinput to the instrument, utilize the TUNING control and slowly tune across the 100 kHz to 1000 MHz frequency range of the unit.

c. Observe that the residual response does not exceed 20 dBuV.

SECTION V
Service, Maintenance and Calibration

5.1 GENERAL

This section provides the information necessary for the proper maintenance, calibration, troubleshooting, and repair of the ESA-1000 Spectrum Analyzer. Failure to follow these procedures could violate the terms of the manufacturer's warranty, plus compromise the reliability, operation, and integrity of the instrument.

5.2 MAINTENANCE/CALIBRATION/ REPAIR

5.2.1 Maintenance. To ensure accurate and trouble-free operation of the ESA-1000, it is recommended that a periodic maintenance schedule be initiated on a six month or 500-750 hours of operational time basis. The performance test procedures of Section IV should be included as part of the maintenance procedure to assess the instrument's overall performance.

5.2.2 Calibration. The calibration procedures of Section 5.7 are utilized as follows:

a. To align and recalibrate the instrument after repair work has taken place.
b. As part of the periodic maintenance schedule to maintain the accuracy of the instrument to the required specifications.

5.2.3 Repair. Repair should be undertaken when one of the following conditions exists:

a. There is an obvious fault in the instrument's operation.
b. Operation is outside the specification limits and cannot be restored by recalibrating the ESA-1000.

5.3 PRELIMINARY PRECAUTIONS AND CONSIDERATIONS

WARNING
HIGH VOLTAGE

Voltages of up to 2 KV or greater are present in this instrument. Use caution whenever working on or near the high voltage supplies or around the CRT. Serious injury or death may result from contact with the high voltage lines.

5.3.1 GENERAL PRECAUTIONS

a. The instrument is to be operated on 115 VAC ± 10% 50/60 Hz only.
b. The instrument should always be operated connected to a suitable ground plane either via the ground prong on the AC power cable or the ground terminal on the unit's rear panel.
c. Always place the instrument's AC power switch to OFF before proceeding to remove or replace components within the instrument.
d. Use caution when making power on measurements to prevent accidental shorting from occurring.
e. As noted above, the instrument utilizes high voltages up to 2 KV. Always exercise extreme caution when working or troubleshooting around the high voltage circuits. Before repairing/replacing or working on components in these sections, remove the unit totally from the AC power source and wait a minimum of 5 minutes before proceeding.
f. If replacement of the CRT is required, it is recommended that the instrument be returned to the factory for this operation. When replacement in the field is necessary, follow the instructions given in Section 5.63 and contact Electro-Metrics or its representatives for assistance if required.
g. If it is determined that the RF Block (MEP-262) is defective, the block must be replaced. Again returning the instrument to the factory for RF Block replacement is recommended, when field replacement is necessary follow the instructions given in Section 5.6.5. Contact Electro-Metrics or its representatives for assistance if required.

NOTE: The protruding screw on the RF Block is for adjusting the 1153 MHz Band Pass Filter Cavity and the 2nd Local Oscillator. Do not adjust or accidentally turn this screw.

5.3.2 Table 5.1 gives the test equipment required to perform the calibration and troubleshooting procedures.

5.4 TROUBLESHOOTING

5.4.1 The procedure for troubleshooting the ESA-1000 is similar to that employed for other electronic equipment. This consists of pinpointing the source/cause of the malfunction by the process of logically eliminating alternate possibilities. By eliminating the greatest number of possibilities with one check, this process will quickly narrow the remaining choices until the defective component or circuitry is isolated.

To facilitate troubleshooting the ESA-1000, the Troubleshooting Sequence Guide Figure 5.22 through 5.34 can be utilized as a guide. Use the checkpoints and voltages listed to aid in isolating and determining the area of circuit malfunctioning. For any assistance required, contact the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT (518-843-2600).

5.5 REPAIR PROCEDURES

5.5.1 Use the Troubleshooting Sequence Guide to isolate the section of the instrument where the circuit malfunction is occurring and its cause.

TABLE 5.1 Recommended Test Equipment

Equipment	Performance Ratings	Recommendation
Signal Generator	Frequency: 1 MHz to 500 MHz Output level: 117μ (50Ω) Output impedance: 50Ω Output level flatness: Within ± 0.5 dB Frequency accuracy: Within ± 1% Noise sideband: - 140 dB away from 200 Hz carrier	Hewlett Packard 8640B
Frequency Counter	Frequency: 10 Hz to 100 MHz Sensitivity: 10 mVrms Stability: 5x10^{-8}/day	
High Frequency Power Meter	Frequency: 100 kHz to 1500 MHz Sensitivity: ≧30 dBm to +20 dBm Accuracy: ±0.5 dB	Hewlett Packard 435B with 8484A Power Senser
Attenuator	Frequency: DC to 500 MHz Attenuation: 0 to 80 dB on 10 dB step Accuracy: ±1.5 dB	Hewlett Packard 355D
Digital Voltmeter	Range: OV to ± 1000 V Accuracy: ±0.1% Input impedance: ≳ 10 MΩ	Datatech Model 40
DC High Voltage Probe	Range ±3000 VDC	
Oscilloscope	Frequency: DC to 10 MHz Sensitivity: 10 mV/DIV.	
Voltage Probe	Attenuation: 10 : 1 Input impedance: 10 MΩ Max. DC voltage: 500 V	

NOTE: Equivalent equipment can be substituted for those recommended.

5.5.2 Use the information obtained to determine whether to repair or replace the defective module, board, or component.

5.5.3 PRINTED CIRCUIT BOARD PRECAUTIONS

a. Do not remove circuit boards (or any other components) while power is applied to the unit. Always turn off and disconnect all external power before proceeding.
b. Never touch the printed surface with bare fingers; skin oils can create leakage paths.
c. Use a grounded soldering iron (20W to 30W) to avoid destruction of IC's and semiconductors.
d. Avoid excessive heat when repairing a board.
e. After repair, clean the printed surface of all contaminants, excess solder, and resin using a freon-base cleaner. Check that excess solder has not created new circuit paths.

NOTE: After any general repair work, always clean the repaired area with a freon-base cleaner.

5.6 DISASSEMBLY/REPLACEMENT

5.6.1 The majority of modules, P.C. boards, and subassemblies can be removed by following the ESA-1000 Assembly Guide Figure 7.

5.6.2 Top and Bottom Covers Removal. To remove the top and bottom covers from the unit, remove the four Phillips machine screws holding each cover. Each cover is then liften up and out. To replace the covers, reverse the procedure.

5.6.3 CRT REPLACEMENT

a. Remove the top and bottom cover as per Section 5.6.2.
b. Disconnect and remove the lead wires from the CRT coil as shown in Figure 5.1.
c. Remove the CRT DRIVER board (SG210) by removing the four Phillips machine screws and the two connectors from the board.
d. Remove the CRT socket marked 1 in Figure 5.2.
e. Loosen the four Phillips screws for the CRT band (marked 2 in Figure 5.2). For additional information see Figure 5.3.
f. Loosen the Phillips screw marked 3 in Figure 5.2.
g. Remove the entire CRT and shield assembly by pulling the assembly back from the front of the unit, then lifting up and out.
h. Carefully pull the CRT Tube through the front of the shield assembly.
i. Install a new CRT tube (Stock No. 140-BMB31) by reversing the procedure given above.
j. Perform the CRT DRIVER adjustment procedure of Section V.
k. Replace the top and bottom covers as per Section 5.6.2.

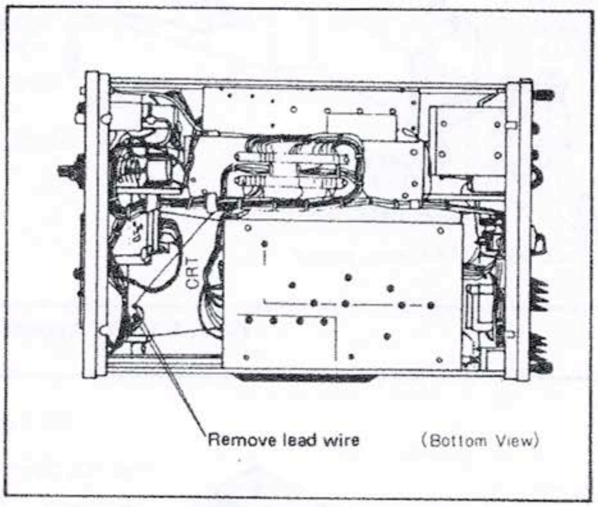


Figure 5.1 CRT Replacement
(Bottom View)

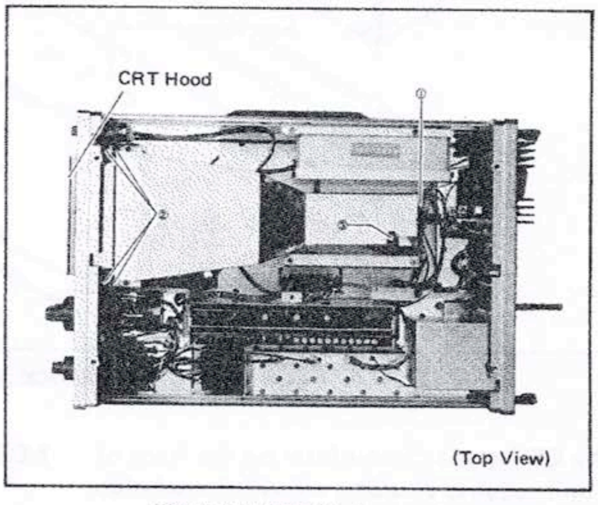


Figure 5.2 CRT Replacement
(Top View)

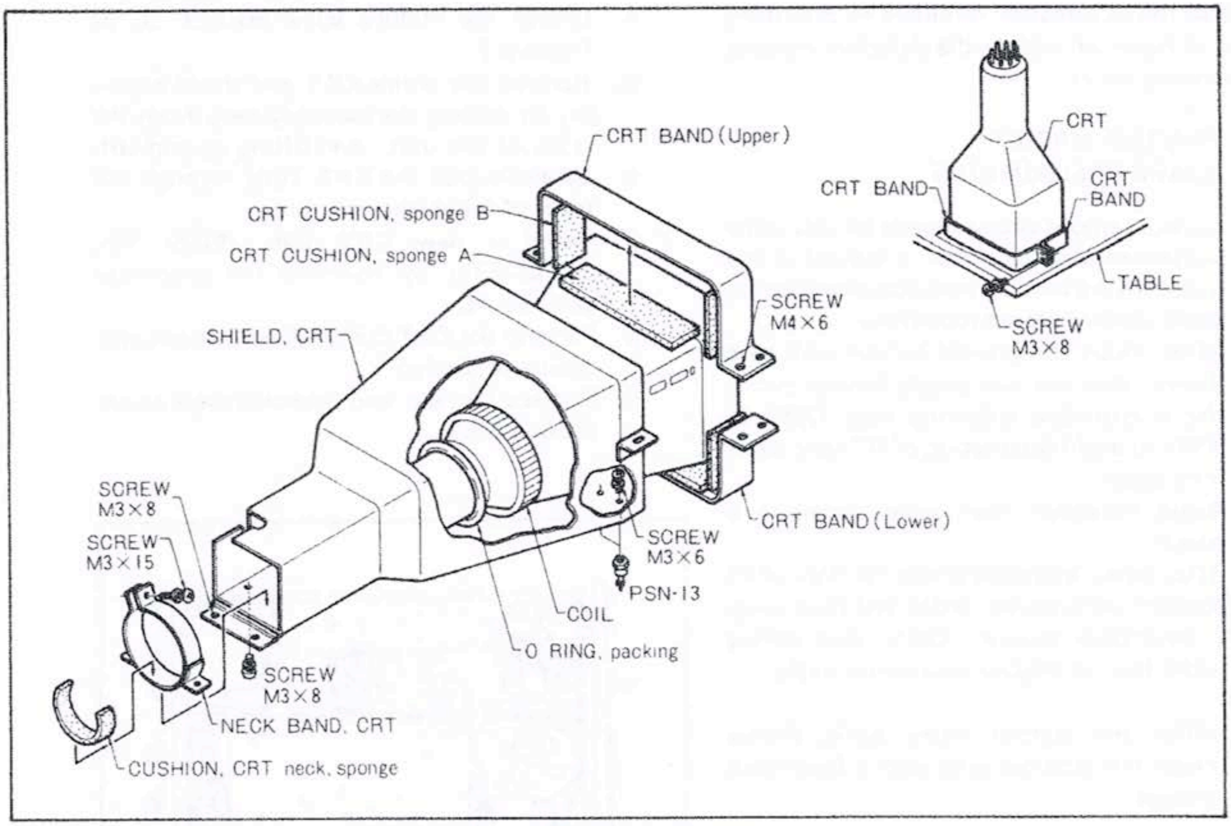

CRT BAND (Upper)
CRT CUSHION, sponge B
CRT CUSHION, sponge A
SHIELD, CRT
SCREW M4×6
CRT BAND
CRT
CRT BAND
TABLE
SCREW M3×8
SCREW M3×8
SCREW M3×15
SCREW M3×6
PSN-13
COIL
O RING, packing
CRT BAND (Lower)
SCREW M3×8
NECK BAND, CRT
CUSHION, CRT neck, sponge

Figure 5.3 CRT Assembly Diagram

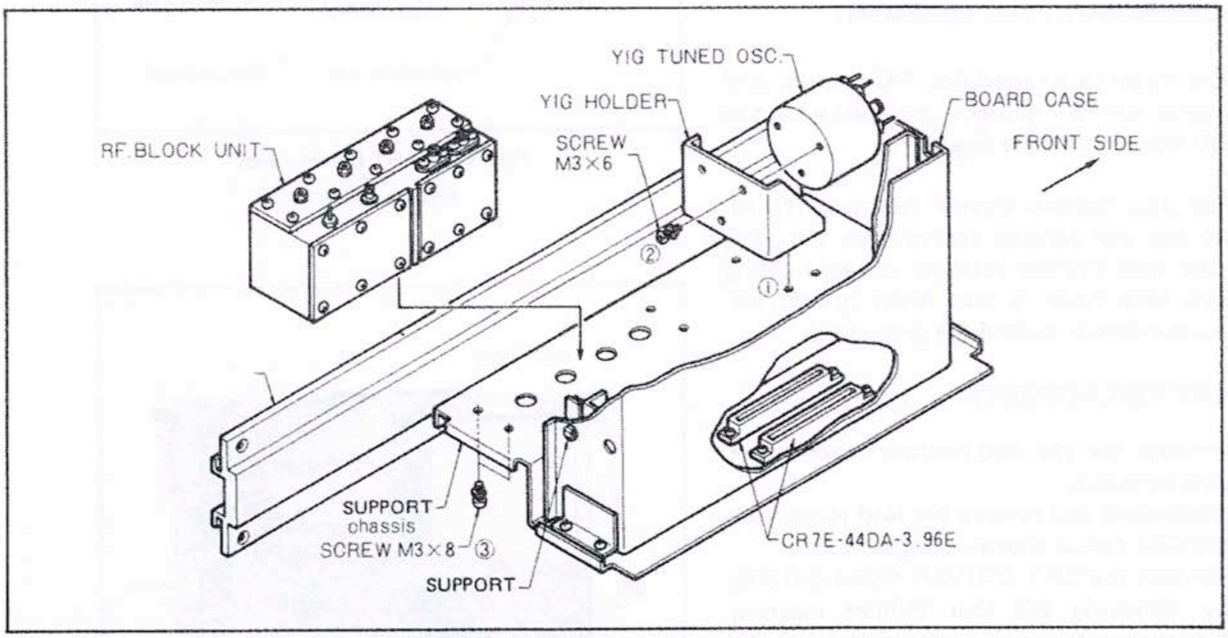

YIG TUNED OSC.
YIG HOLDER
BOARD CASE
FRONT SIDE
RF.BLOCK UNIT
SCREW M3×6
②
①
SUPPORT chassis
SCREW M3×8 ③
SUPPORT
CR7E-44DA-3.96E

Figure 5.4 YIG & RF. BLOCK Assembly Diagram

1. If the CRT graticule and filter on the front of the unit requires cleaning, use either a solution of soap and water or an alcohol based glass cleaner. Wipe dry with a soft clean cloth.

NOTE: The front panel CRT Hood and filter can be removed by removing the four Phillips machine screw on the CRT Hood.

5.6.4 YIG TUNED OSCILLATOR REPLACEMENT

a. Remove the top and bottom covers as per Section 5.6.2.
b. Remove the four Phillips machine screws (marked 1 in Figure 5.4) which fasten the YIG holder bracket to the RF BLOCK Assembly.
c. Remove the wires connected to the YIG connector terminals.
d. Remove the three Phillips machine screws (marked 2 in Figure 5.4) which mount the YIG Oscillator to the YIG holder bracket.
e. Install a new YIG Oscillator (Stock No. MEP-158) by reversing the procedure given above. Take care to remount the YIG Oscillator and YIG holder bracket correctly.
f. Perform the Performance Tests in Section 4.4.11 and 4.4.13 and the calibration adjustment procedures Section 5.7.6.

5.6.5 RF BLOCK REPLACEMENT

a. Remove the top and bottom covers as per Section 5.6.2.
b. To remove the RF Block Assembly, remove the four Phillips machine screws which mount the assembly to the support bracket (marked 3 in Figure 5.4).
c. Install a new RF Block Assembly (Stock No. MEP-262) by reversing the procedure given above.

CAUTION

Do not accidentally adjust or move the projecting screw on the RF Block Assembly, which is for adjusting the 1153 MHz Band Pass Filter Cavity and the 2nd LO Oscillator.

d. Perform the calibration check of Section 5.7.8. (Optional).

5.7 CALIBRATION PROCEDURES

5.7.1 General. The calibration procedures for the ESA-1000 are normally utilized to recalibrate the instrument after repair work has been performed or when the performance test procedures of Section IV show the unit not meeting the required specifications. The test equipment required for calibration is listed in Table 5.1.

5.7.1.1 All the following procedures are performed with the POWER MODE switch set to the AC position and the unit connected to a 115 VAC ±10% 50/60 Hz power source. In addition the unit has both covers removed (See Section 5.6.2) for performing the adjustments and tests required.

5.7.2 INITIAL TESTS AND SETTINGS

5.7.2.1 POWER SUPPLY CHECKS

a. Starting with the AC POWER switch OFF – check the resistance to ground and with the AC POWER switch ON – the DC voltages on the following pins of connector J2 (located at the bottom of the unit) with a digital voltmeter.

Pin	DC Voltage	Resistance to Ground
J2-19A1B	+15 VDC ± 0.6 V	86 to 88 ohms
J2-18A1B	- 15 VDC ± 0.6 V	86 to 88 ohms
J2-17A1B	+5 VDC ± 0.2 V	86 to 88 ohms

b. In the same manner check the resistance and DC voltages on the following:

IC4-Pin 2	+24 VDC ± 1.2 V	86 r to 88 r
D5 Cathode	Approx. 260 VDC	131 r to 133 r

These two components are located on the inside of the rear panel.

c. Checking the High Voltage Power Supply.
   1. Set the AC POWER switch to OFF.
   2. Remove the CRT DRIVER board (SG210) by removing the four Phillips machine screws and connection fastening it to the unit. Also remove the CRT socket from the rear of the CRT tube.
   3. Proceeding with caution and care, measure the pin voltages on the CRT socket with a high voltage probe and digital voltmeter.

Pin 1, 14 (H)	-2.01 KV
Pin 2, (G1)[1]	-2.01 KV to -2.08 KV
Pin 3, (K)	-2.01 KV
Pin 4, (P1)[2]	-1.38 KV to -1.97 KV
Pin 6, (G2)	+100 VDC

1 : INTENSITY control voltage
2 : FOCUS control voltage

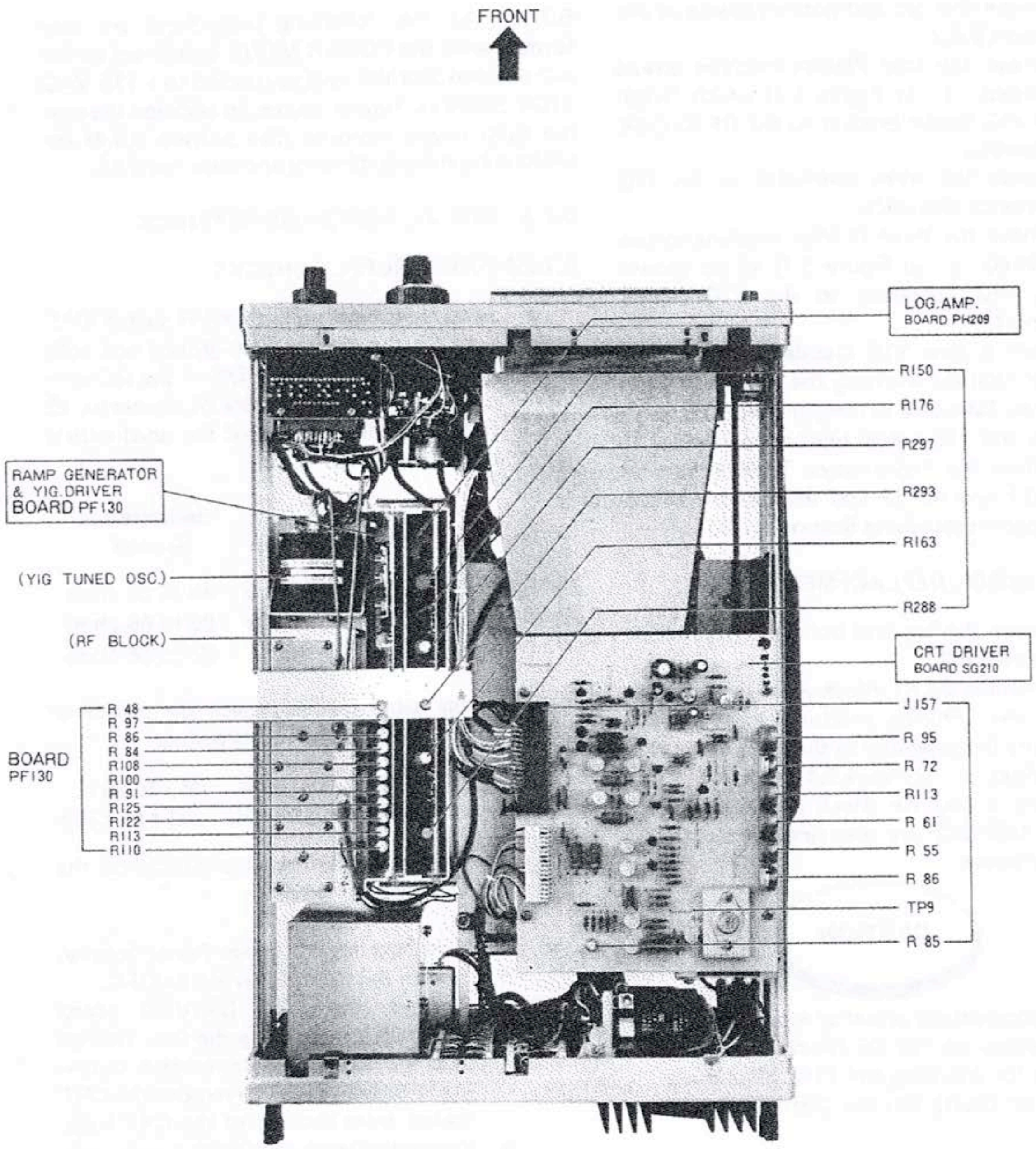

FRONT
LOG.AMP.
BOARD PH209
R150
R176
R297
R293
R163
R288
RAMP GENERATOR
& YIG.DRIVER
BOARD PF130
(YIG TUNED OSC.)
(RF BLOCK)
CRT DRIVER
BOARD SG210
R 48
R 97
R 86
R 84
R108
R100
R 91
R125
R122
R113
R110
BOARD
PF130
J157
R 95
R 72
R113
R 61
R 55
R 86
TP9
R 85

Figure 5.5 ESA-1000 Top View

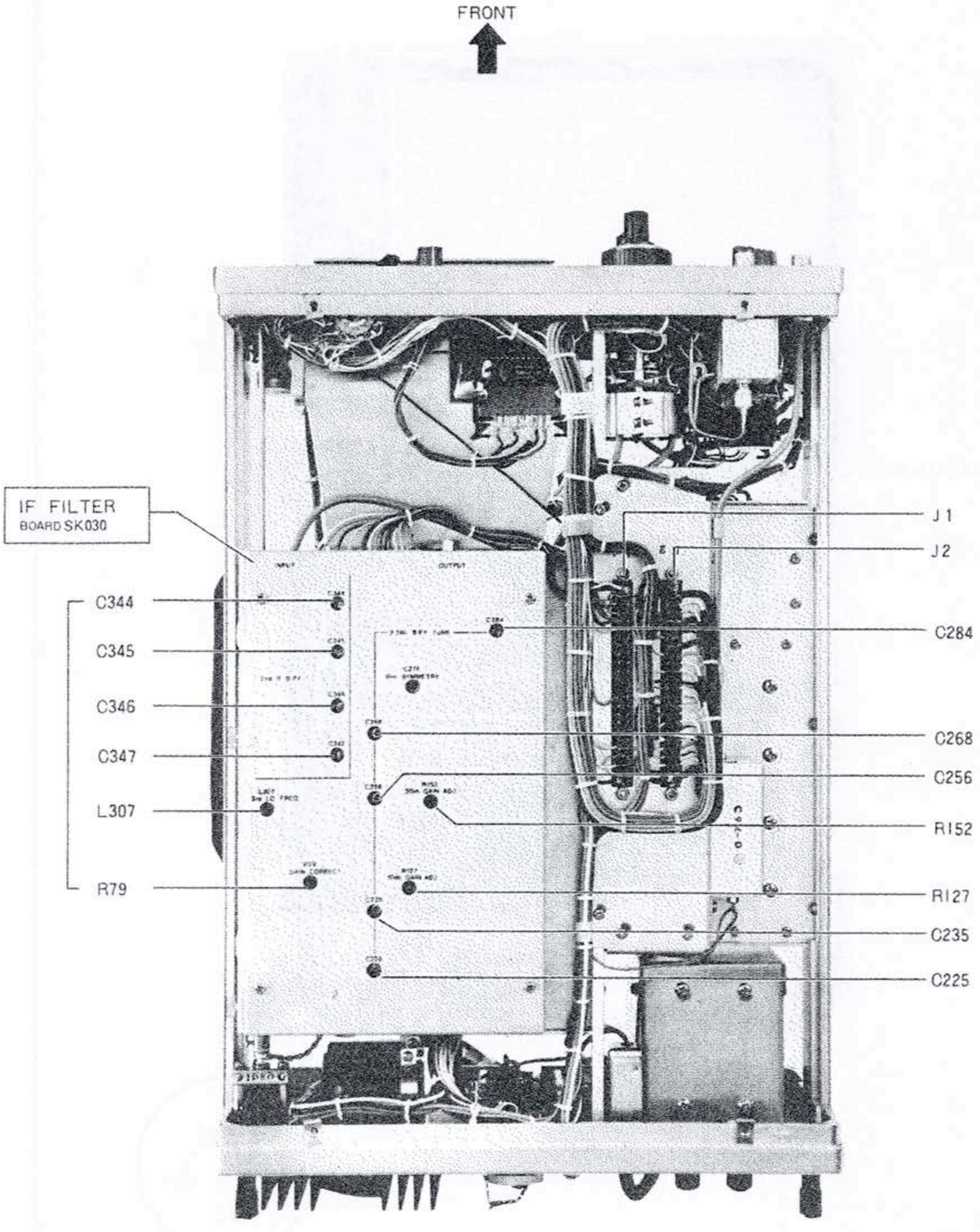

FRONT
IF FILTER
BOARD SK030
C344
C345
C346
C347
L307
R79
J1
J2
C284
C268
C256
R152
R127
C235
C225

Figure 5.6 ESA-1000 Bottom View

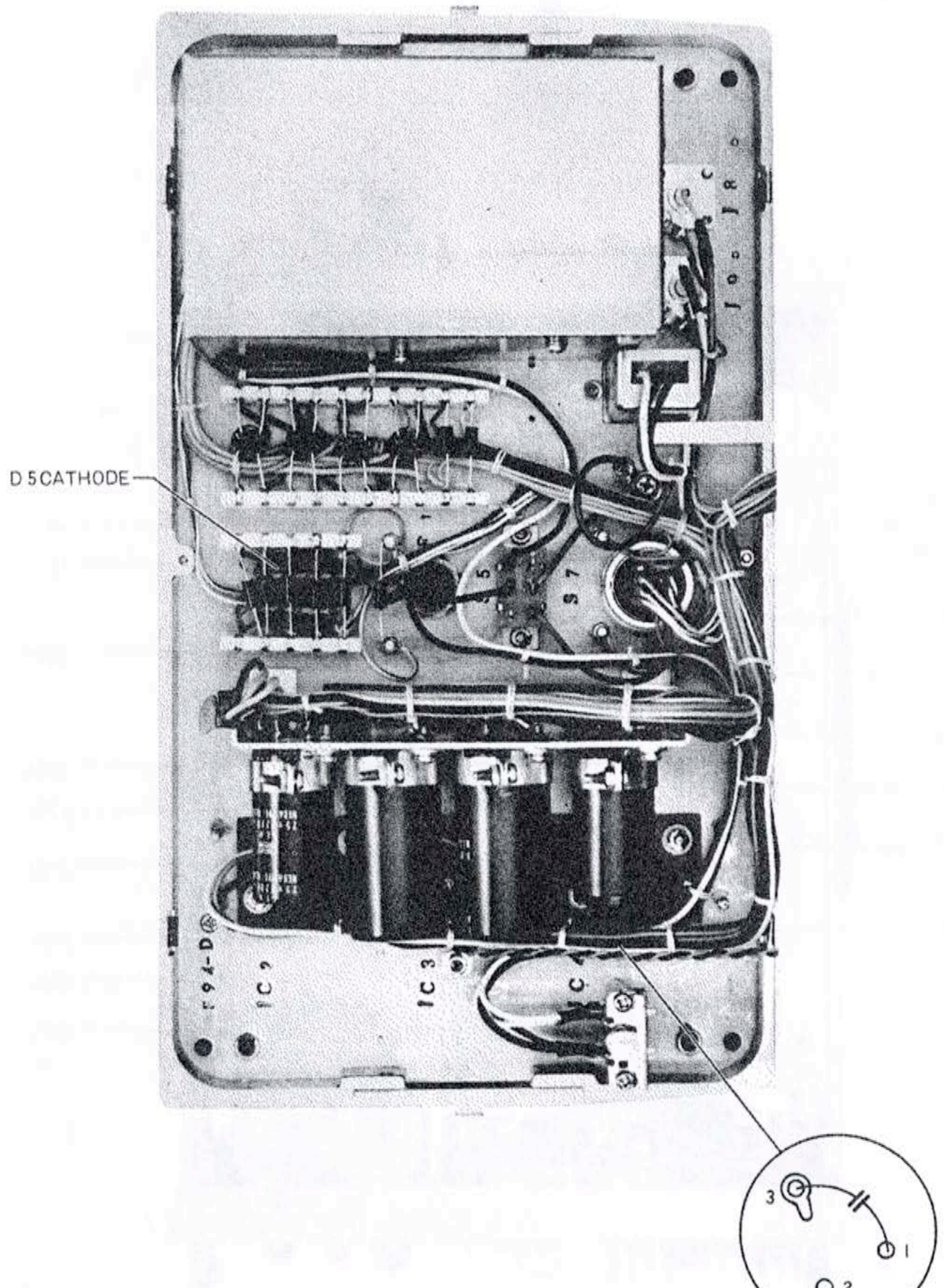

D 5CATHODE
3
1
2
IC4

Figure 5.7 ESA-1000 Rear View

"WARNING"

Serious injury or death can result from contact with the high voltage lines. Always exercise extreme caution and care when working with or around high voltage. Remember careful, cautious, and correct is better than quick, damaged, and injured.

After the CRT voltages have been checked; turn the AC POWER OFF, connect the CRT socket to the CRT tube, and reconnect and fasten down the CRT DRIVER board SG210.

5.7.2.2 PRELIMINARY PROCEDURE

a. Set the ESA-1000 front panel controls as follows:

INTENSITY	Center
FOCUS	Center
SCAN MODE	AUTO
DETECTION MODE	MEAN (VIDEO FILTER OFF)
SCAN TIME (MANUAL SCAN)	20 ms
REFERENCE LEVEL	INPUT LEVEL
VERTICAL AXIS SCALE SELECTOR	10 dB/DIV.
IF GAIN (dB)	0 dB, CAL.
RF. ATT.	0 dB
DISPERSION/DIV.	100 MHz
B.W. (Hz) 6 dB	AUTO
TUNING/PRESET	TUNING

b. Place the AC POWER switch to its ON position, the LED readouts for the REFERENCE LEVEL and CENTER FREQUENCY will illuminate. The REFERENCE LEVEL readout should indicate 110 dBuV. Utilize the TUNING control to set the CENTER FREQUENCY readout at 000 MHz indication.

c. Approximately 20 seconds after AC power turn on, a zero frequency trace should appear on the CRT DISPLAY. If the trace does not appear, turn the INTENSITY control clockwise. Likewise if the trace brightness is too strong, turn the INTENSITY control counterclockwise.

CAUTION

To avoid damaging the CRT, refrain from operating the CRT at full intensity for long periods of time.

d. If the trace is not sharply defined, adjust the FOCUS control.

e. If the zero frequency trace is tilted with respect to the vertical axis of CRT graticule markings, adjust the TRACE ALIGN control with a screwdriver as shown in Figure 3.4.

f. Connect the CAL OUT to the INPUT of the unit. Allow the unit to warm up in this condition for 30 minutes before proceeding with the calibration procedures.

5.7.3 CRT DRIVER Board (SG210) Adjustment

Equipment used: Digital Voltmeter

5.7.3.1 CRT BIAS VOLTAGE Adjustment

a. Connect the Digital Voltmeter to TP9 on the CRT DRIVER board.

b. Adjust R85 for +170 VDC ±1 V on the voltmeter.

5.7.3.2 FOCUS Adjustment

a. Reset the following ESA-1000 front panel controls.

CENTER FREQUENCY	100 MHz
SCAN MODE	MANUAL
DISPERSION/DIV.	ZERO
B.W.	1.5 MHz

b. Center the resulting bright spot on the CRT by utilizing the MANUAL SCAN and FINE TUNING controls. Use the INTENSITY control to reduce the trace brightness. Adjust R86 (ASTIG) in conjunction with the front panel FOCUS control for a sharp trace.

c. Return the SCAN MODE switch to the AUTO position.

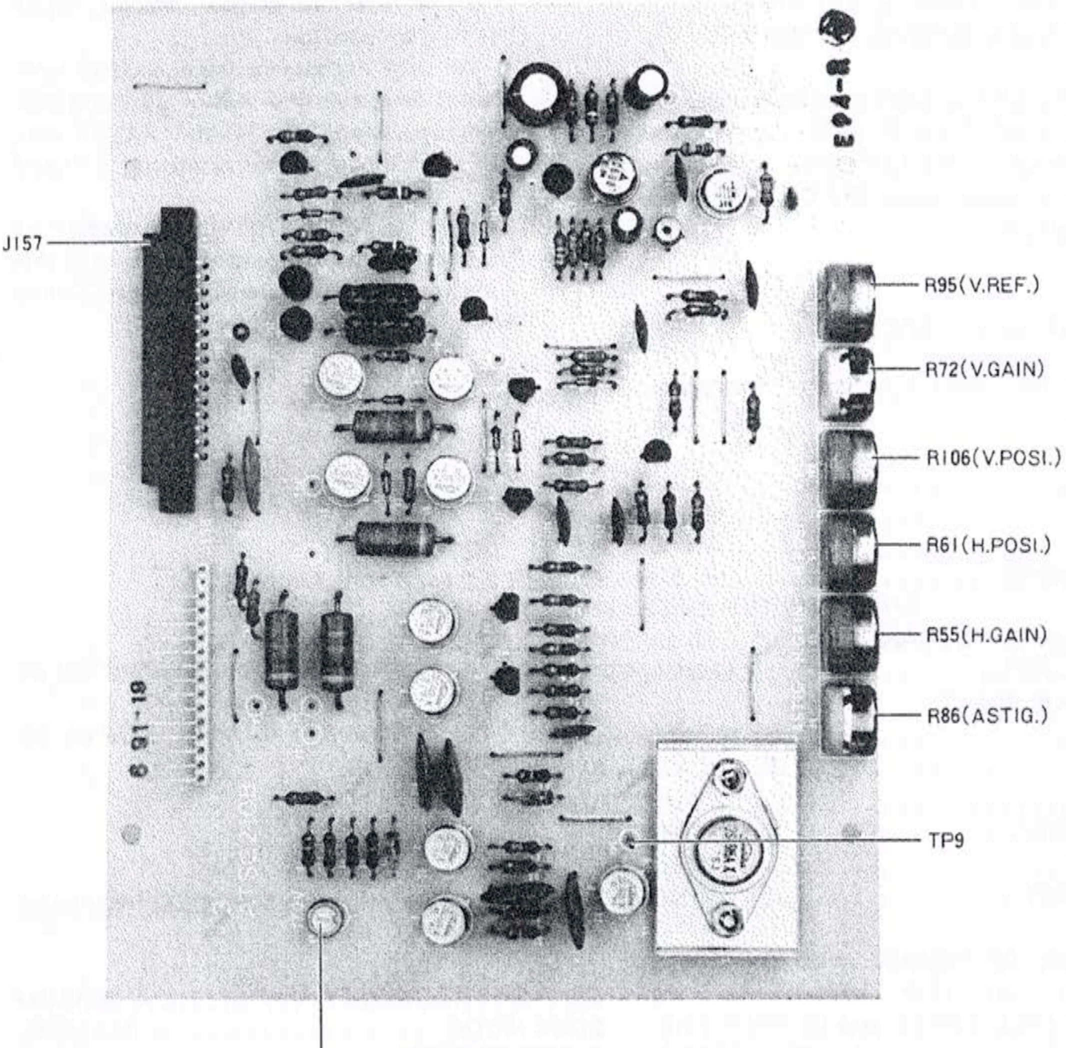

J157
R95(V.REF.)
R72(V.GAIN)
R106(V.POSI.)
R61(H.POSI.)
R55(H.GAIN)
R86(ASTIG.)
TP9
R85(170V)

Figure 5.8 CRT DRIVER BD. (SG210)

5.7.3.3 VERTICAL AXIS Adjustment

a. Retaining the front panel control settings of Section 5.7.3.2, connect the voltmeter to Pin 2 of Connector J157. Adjust the TUNING and FINE TUNING controls for a reading of +2.0 VDC to ± 0.05 V on the voltmeter.

b. Adjust R113 (V. POSI) to set the trace at the -40 dB level on the CRT (40 dB down from the Reference point).

c. Set the outer section of the IF GAIN switch to the 30 dB position. Utilizing the FINE TUNING plus the inner section of the IF GAIN switch or adjust the voltage at Pin 2 of Connector J2 to +4.0 VDC ± 0.05 V.

d. Adjust R72 (V. GAIN) to set the trace to the 0 dB line of the CRT graticule.

e. Due to interaction between adjustments, repeat steps a-d until no further readjustments are necessary.

5.7.3.4 VERTICAL REFERENCE LEVEL Adjustment

a. Repeat the procedure of 5.7.3.3.-c to set the voltage on Connector J2-2 to +40 VDC ±0.05 V.

b. Reset the Vertical Axis Scale Selector switch to the 5 dB/DIV. position. Adjust R95 (U. REF) to set the trace to the top horizontal line of the graticule.

5.7.3.5 HORIZONTAL AXIS Adjustment

a. Reset the front panel controls to the initial settings of Section 5.7.2.2-a modified as per Section 5.7.3.2-a. Adjust the IF GAIN and RF ATTENUATOR switches to set the trace at the -40 dB level on the CRT.

b. Connect the voltmeter to Pin 14 of Connector J157 and set the SCAN MODE switch to the MANUAL position. Adjust the MANUAL SCAN control to set the voltage on Pin 14 to 0.00 VDC.

c. Adjust R61 (H. POSI) to position the bright dot at the center of the CRT.

d. Adjust the MANUAL SCAN to set the voltage on Pin 14 to -4.5 VDC ±0.1 V.

e. Adjust R55 (H. GAIN) to set the bright spot on the left side vertical end line.

f. Due to interaction between adjustments, repeat steps c-e until no further readjustments are necessary.

5.7.3.6 BASELINE Adjustment

a. Disconnect the CAL OUT from the unit's INPUT and reset the front panel controls as follows:

VERTICAL AXIS SCALE
SELECTOR .10 dB/DIV.
IF GAIN . . . . .0 dB, CAL.
B.W. . . . . AUTO

b. Adjust R113 (V. POSI) to set the trace baseline to the CRT graticule bottom line.

5.7.4 CAL. OSC. BOARD (SF145) Adjustment

Equipment used: High Frequency Power Meter (50 r)
Frequency Counter
Signal Generator

5.7.4.1 OUTPUT LEVEL Adjustment

a. Connect the power meter to the CAL OUT of the instrument to measure the CAL OUT output level.

b. Adjust R16 of the CAL OSC. board to set the output level at -27 dBμ.

5.7.4.2 OUTPUT FREQUENCY Adjustment

a. Set the output of the Signal Generator to 100,000 MHz.

b. Connect the output of the Signal Generator to the INPUT of the instrument and set the output level at 80 dBuV. Set the ESA-1000 front panel DISPERSION/DIV. switch to the 0.1 MHz/DIV. position.

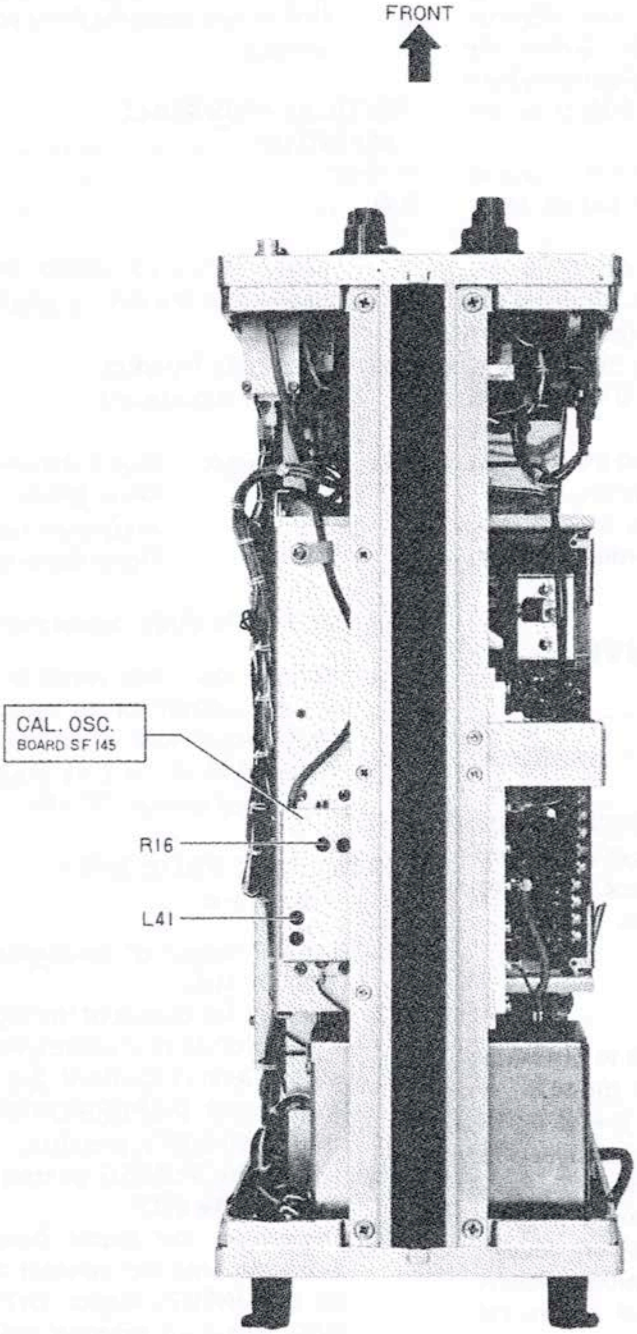
c. Utilize the TUNING control to center the signal on the CRT.

d. Disconnect the Signal Generator output from the unit and connect the CAL OUT to the INPUT. Adjust L41 on the CAL OSC. board to position the signal within ±1.0 divisions of the center line.

5.7.5 LOG AMP BOARD (PH209) Adjustment

Equipment used: Signal Generator
10 dB Step Attenuator

a. Remove the L shaped metal bracket supporting the PF103 and PH209 boards and


FRONT
CAL. OSC.
BOARD SF 145
R16
L41

Note: Remove the connector plate for DM-1000 to adjust those controls.
The connector plate is installed by the two screws on its side.

Figure 5.9 Location of CAL. OSC. Adjustment

remove the PH209 board. Insert the PH209 board into an extender board and re-insert combination into the unit.

b. Reset the following front panel controls from their initial settings of Section 5.7.2.2.

DETECTION MODE .... MEAN
VIDEO FILTER .... 10 kHz

c. As shown in Figure 5.10, disconnect connector J53 from the output of the SK030 board which is the input of the 1 dB step IF Attenuator (MEP-263). Utilizing the UM–UM Adapter (UM-QA-JJ), connect the Signal Generator output (3.33 MHz at +6.0 dBμ) to J53 via the external 10 dB step attenuator.

5.7.5.1 LOG ADJUSTMENT

a. With the test setup given, set the external 10 dB step attenuator to the 0 dB position.

b. Adjust R150 (LOG GAIN) on the LOG AMP board to set the trace on the CRT to the 0 dB level (top horizontal line).

c. Set the external 10 dB step attenuator to the 60 dB position. Adjust R163 (LOG OFFSET) on the LOG AMP board to set the trace on the CRT to the -60 dB level (third horizontal line from CRT bottom).

d. Due to interaction between adjustments, repeat steps b-c until no further readjustments are necessary.

5.7.5.2 LINEAR Adjustment

a. Set the external 10 dB step attenuator to the 40 dB position and the Vertical Axis Scale Selector switch to the LINEAR position.

b. Adjust R176 (LIN. GAIN) on the LOG AMP board to set the trace on the CRT to the 0 dB level (top horizontal line).

5.7.5.3 Q.P. Adjustment

a. Set the external 10 dB step attenuator to the 40 dB position and the Vertical Axis Scale Selector switch to the 10 dB/DIV. position.

b. Set the ESA-1000 DETECTION MODE to the Q.P. position. Adjust R297 (QP3) on

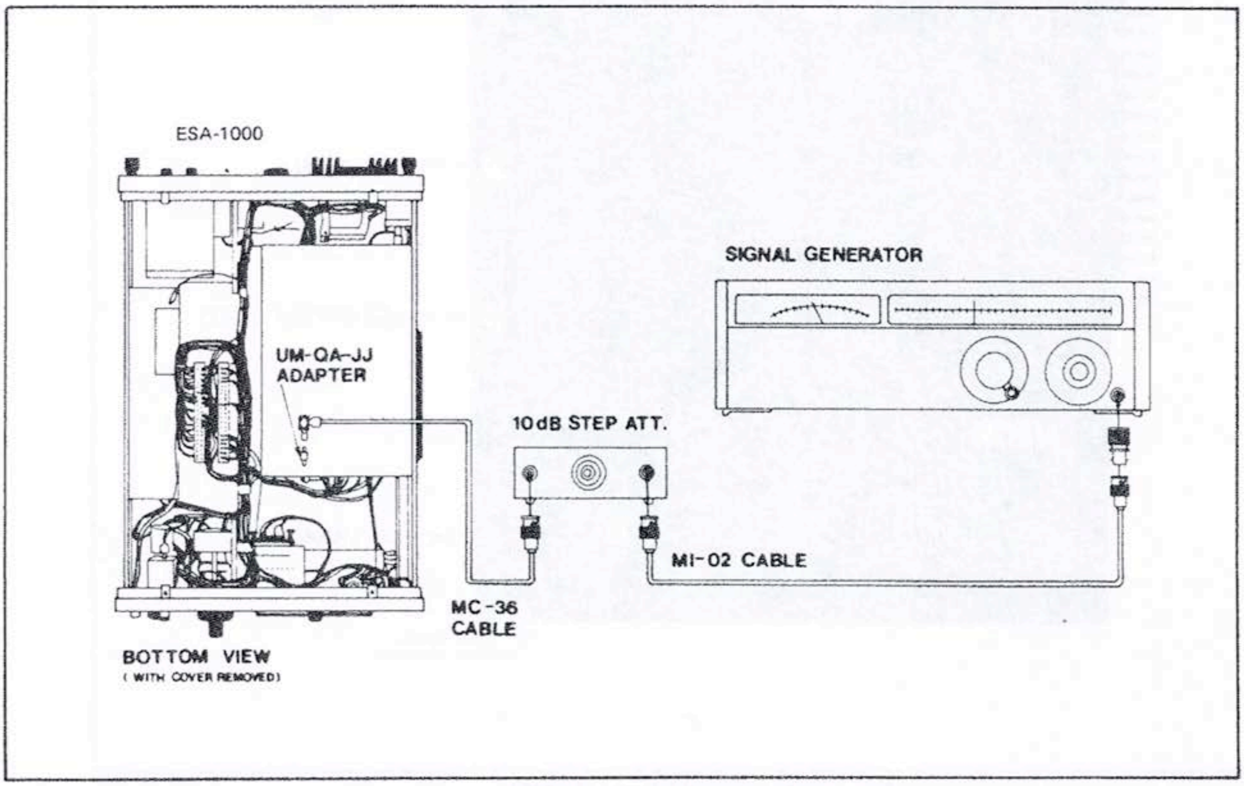


Figure 5.10 LOG. AMP. Adjustment Setup

the LOG AMP board to set the trace on the CRT to the 0 dB level (top horizontal line).

c. Reset the external 10 dB step attenuator to the 70 dB position. Adjust R293 (QP1) on the LOG AMP board to set the trace on the CRT to the - 30 dB level.
d. Reset the external 10 dB step attenuator to the 80 dB position. Adjust R288 (QP2) on the LOG AMP board to set the trace on the CRT to the - 40 dB level.
e. Due to interaction between adjustments, repeat steps c-d until no further readjustments are necessary.

5.7.6 RAMP GENERATOR, YIG DRIVER, AND DISPLAY CONTROL Adjustment

Equipment used: Digital Voltmeter

5.7.6.1 10 VDC Adjustment

a. Connect the Digital Voltmeter to TP1 on the Ramp Generator and YIG Driver board (PF130). Adjust R91 (10 V) for a reading of 10.00 VDC ± 0.005 V on the voltmeter.

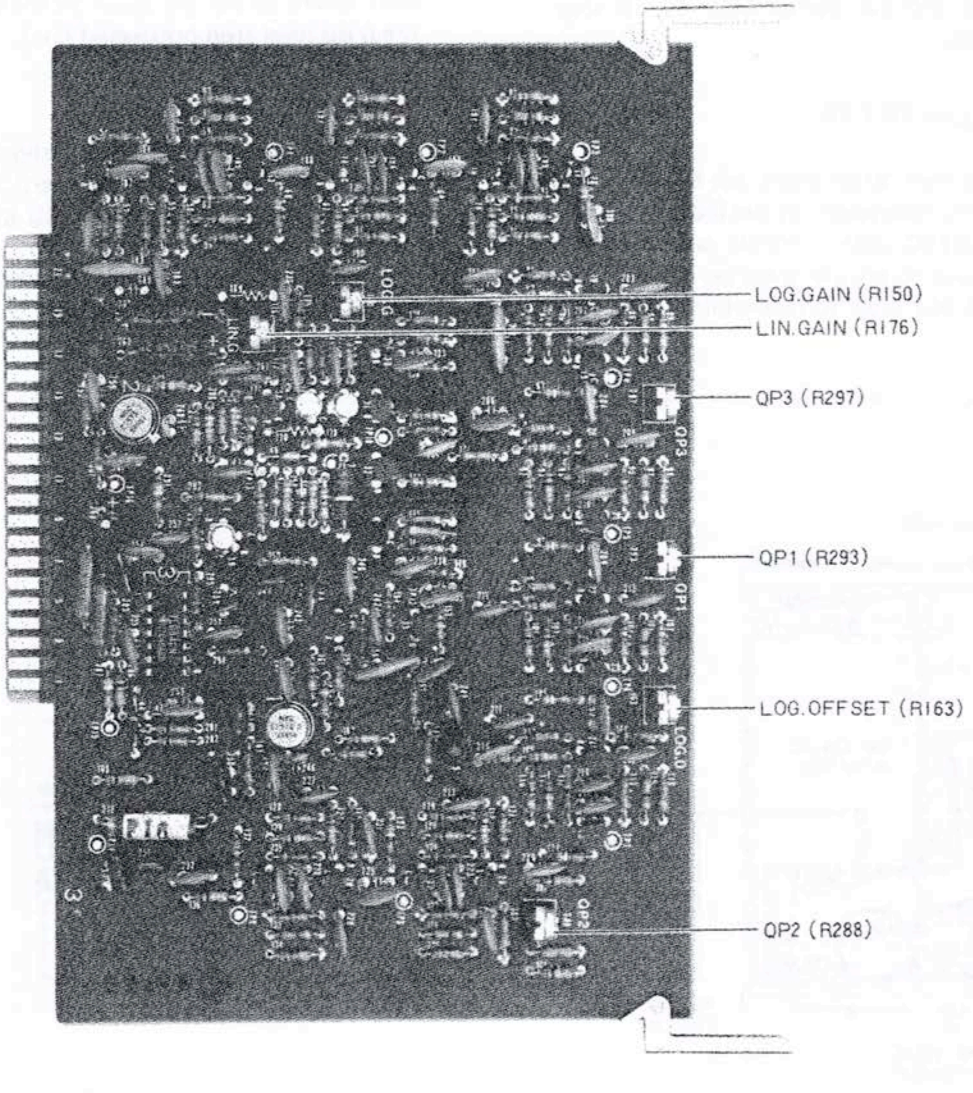


Figure 5.11 LOG AMP Board (PH209)

5.7.6.2 DISPERSION Adjustment

a. Reset the following front panel controls from the initial setting of Section 5.7.2.2:

CENTER FREQUENCY .... 500 MHz
SCAN TIME .... White line at 12 o'clock

b. Adjust R48 (DISP.) on the R.G. and YIG Driver board, while adjusting the front panel TUNING control to set the zero frequency trace to the left hand vertical end line and the 10th harmonic (1000 MHz) signal to the right hand vertical end line with the CAL OUT signal applied to the INPUT.

5.7.6.3 VARIABLE WIDTH Adjustment

a. Again with the CAL OUT signal applied to the INPUT, turn the TUNING control fully counterclockwise. Adjust R84 (LO.F) of the R.G. and YIG Driver board to set the zero frequency trace to the 4th vertical line from the right on the CRT (Figure 5.13A).

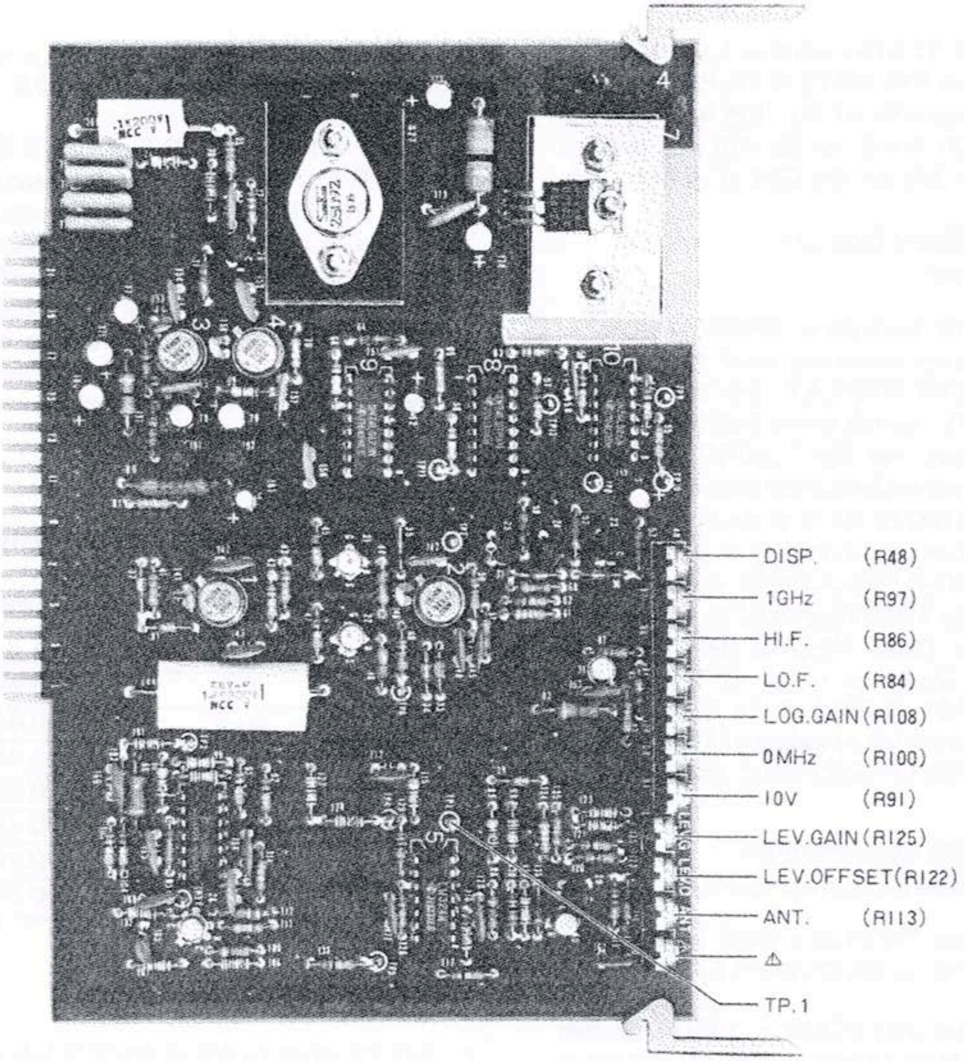

DISP. (R48)
1GHz (R97)
HI.F. (R86)
LO.F. (R84)
LOG.GAIN (R108)
0MHz (R100)
10V (R91)
LEV.GAIN (R125)
LEV.OFFSET (R122)
ANT. (R113)
⚠
TP.1

Figure 5.12 Ramp Generator & YIG Driver Board (PF130)

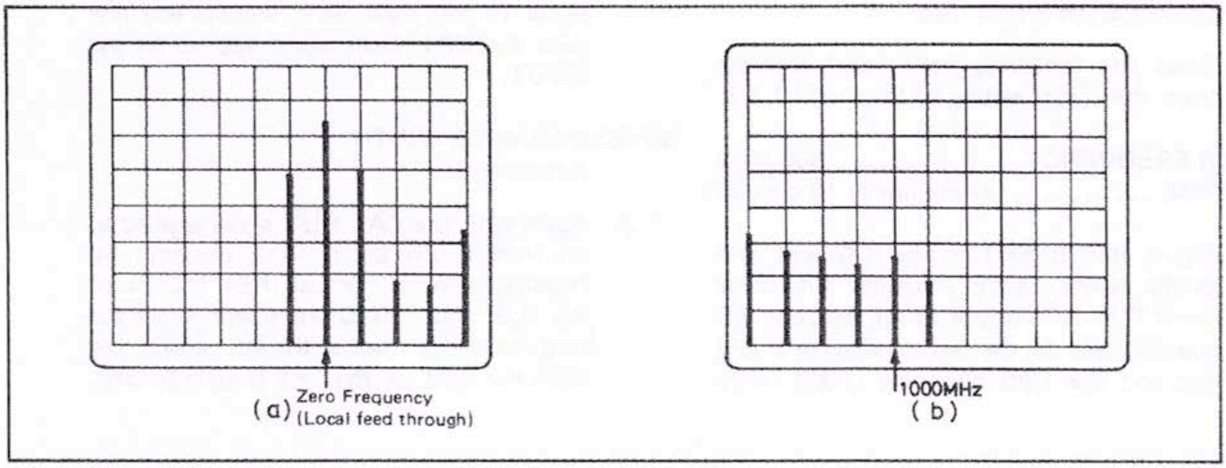


Figure 5.13 Variable Width Adjustment Display

b. Turn the TUNING control fully clockwise and adjust R86 (HI.F) of the R.G. and YIG Driver board to set the 10th harmonic signal (1000 MHz) to the 4th vertical line from the left on the CRT (Figure 5.13B).

5.7.6.4 FREQUENCY DISPLAY Adjustment

a. Adjust the front panel TUNING control to set the zero frequency trace at the center of the CRT DISPLAY. Set the DISPERSION/DIV. switch to the 5 MHz/DIV. position. Again use the TUNING control to center the zero frequency trace.

b. Adjust R100 (0 MHz) of the R.G. and YIG Driver board for a reading of 000 MHz on the CENTER FREQUENCY readout.

c. Adjust the TUNING control to set the 10th harmonic (1000 MHz) of the CAL. OUT signal at the center of the CRT DISPLAY.

d. Adjust R97 (1 GHz) of the R.G. and YIG Driver board for a reading of 1000 MHz on the CENTER FREQUENCY readout.

5.7.6.5 ANTENNA COEFFICIENT COMPENSATION Adjustment

a. Adjust the TUNING control for a reading of 34 MHz on the CENTER FREQUENCY readout.

b. Reset the REFERENCE LEVEL switch from INPUT LEVEL to the ANTENNA-A position. Adjust R113 (ANT.) of the R.G. and YIG Driver board to keep the reading on the REFERENCE LEVEL readout unchanged.

c. Adjust the TUNING control for a reading of 1000 MHz on the CENTER FREQUENCY readout.

d. Adjust R108 (LOG G.) of the R.G. and YIG Driver board so that the reading on the REFERENCE LEVEL readout increases by a value of 31 dB when switching between INPUT LEVEL and ANTENNA A.

c. Adjust R110 (Δ) of the R.G. and YIG Driver board so that the reading on the REFERENCE LEVEL readout decreases by a value of 5 dB when switching between ANTENNA-A and ANTENNA-B.

TABLE 5.2 Level Display Adjustment Settings

IF GAIN	RF. ATT.	LED Display
30 dB	0 dB	80 dBμ
20 dB	0 dB	90 dBμ
10 dB	0 dB	100 dBμ
0 dB	0 dB	110 dBμ
0 dB	10 dB	120 dBμ
0 dB	20 dB	130 dBμ
0 dB	30 dB	140 dBμ
0 dB	40 dB	150 dBμ

5.7.6.6 LEVEL DISPLAY Adjustment

a. Set the inner switch of the IF GAIN switch to the CAL position. Adjust R125 (LEV. G) and R122 (LEV. O) of the R.G. and YIG Driver board so that the REFERENCE LEVEL readout displays the values shown for the combined IF GAIN and RF ATTENUATOR switch settings shown in Table 5.2

5.7.7 IF FILTER Adjustment

Equipment used: Spectrum Analyzer (Optional)

NOTE: The Spectrum Analyzer is utilized only for Section 5.7.7.1 of the following procedure. If a Spectrum Analyzer or other suitable equipment is not available, the remaining sections of the procedure can be performed as described since Section 5.7.7.1 has no effect on the other procedures.

5.7.7.1 3rd LOCAL OSCILLATOR Adjustment (Optional)

a. Remove the cover over the IF FILTER board (SK030) and loosely couple by L307 to the Spectrum Analyzer (Figure 5.14). Adjust L307 so that the 3rd Local Oscillator frequency read by the Spectrum Analyzer is 43.3 MHz ± 1 MHz. If problems are suspected with the 3rd Local Oscillator, return the unit to the factory for repair.

NOTE: The 3rd Local Oscillator has a very stable output frequency, no adjustments are normally required.

5.7.7.2 300 kHz to 9 kHz BAND PASS FILTER Adjustment

a. Connect the CAL OUT signal to the INPUT and reset the following front panel controls from the initial settings of 5.7.2.2.

CENTER FREQUENCY	100 MHz
SCAN TIME	11 o'clock
VERTICAL AXIS SCALE SELECTOR	5 dB/DIV.
IF GAIN	10 dB
DISPERSION/DIV.	0.1 MHz/DIV.
B.W.	9 kHz

b. Use the TUNING and FINE TUNING controls to center the 100 MHz CAL signal on the CRT.

c. Adjust C284 of the IF Filter board (see Figure 5.15) to null the signal to its lowest point (Figure 5.16).

d. Adjust C225, C235, C256, and C268 of the IF FILTER board to peak the signal to its highest level.

e. Due to interactions between adjustments, repeat steps c-d until no further readjustments are necessary.

5.7.7.3 BANDWIDTH SWITCHING LEVEL ERROR Adjustment

a. Reset the BANDWIDTH switch to the AUTO position and the DISPERSION/DIV. switch to the 100 MHz/DIV. position.

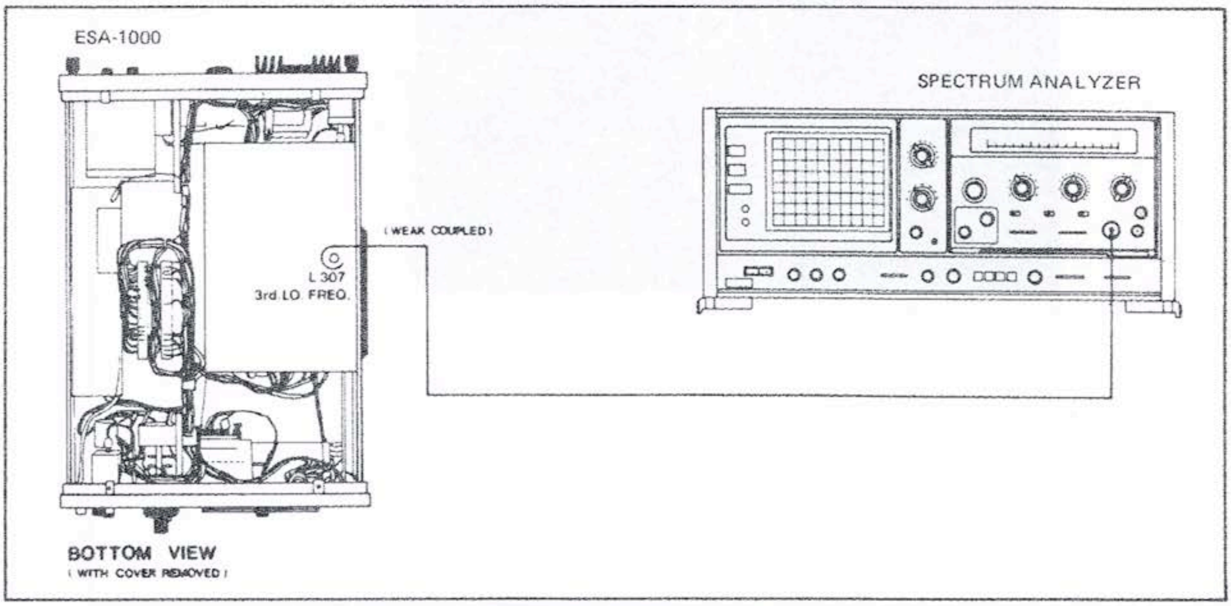


Figure 5.14 IF FILTER Adjustment Setup (Optional)

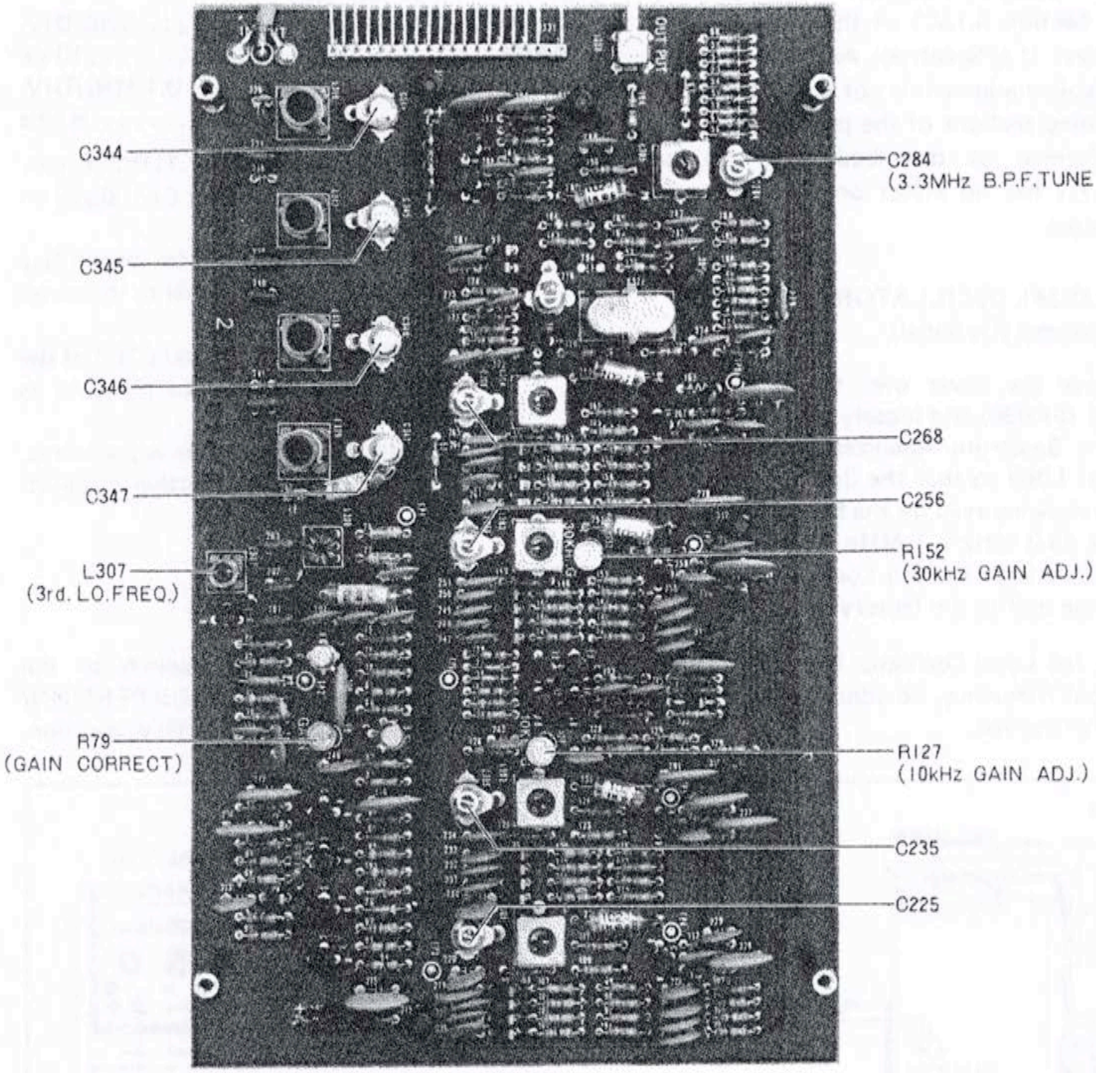

C344
C345
C346
C347
L307
(3rd. LO.FREQ.)
R79
(GAIN CORRECT)
C284
(3.3MHz B.P.F.TUNE
C268
C256
R152
(30kHz GAIN ADJ.)
R127
(10kHz GAIN ADJ.)
C235
C225

Figure 5.15 IF FILTER BD. (SK030) Adjustments

b. Adjust the outer and inner sections of the IF GAIN switch to set the 100 MHz CAL signal peak at the center of the CRT.

c. Adjust R152 (30 kHz GAIN ADJ.) of the IF FILTER board to center the signal peak on the CRT when the DISPERSION/DIV. switch is set to the 2 MHz/DIV. position.

d. Also adjust R127 (10 kHz GAIN ADJ.) to center the signal peak when the DISPERSION/DIV. switch is set to the 0.2 MHz/DIV. position.

e. Due to interactions between adjustments, repeat steps c-d until no further readjustments are necessary.

5.7.7.4 1.5 MHz BANDWIDTH Adjustment

Equipment used: Signal Generator

a. Reset the following front panel controls from the initial settings of Section 5.7.2.2.

CENTER FREQUENCY .... 100 MHz
DISPERSION/DIV. .... 0.5 MHz/DIV.
B.W. .... 1.5 MHz
RF. ATT. (dB) .... 0 dB

b. Connect the Signal Generator output (100 MHz at +10 dBμ) to the INPUT of the instrument.

c. Set the outer section of the IF GAIN switch to the +30 dB position and carefully observe the CRT DISPLAY. If the upper section of the signal curve has become irregular (see Figure 5.17), adjust C344 to C347 of the IF FILTER board.

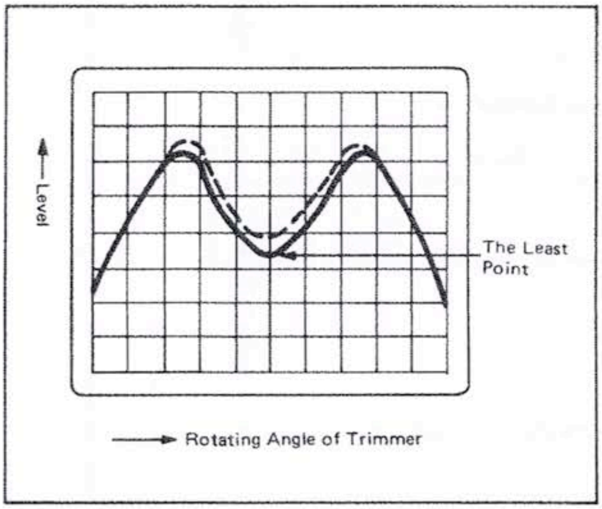


Figure 5.16 B.P.F. Adjustment Display

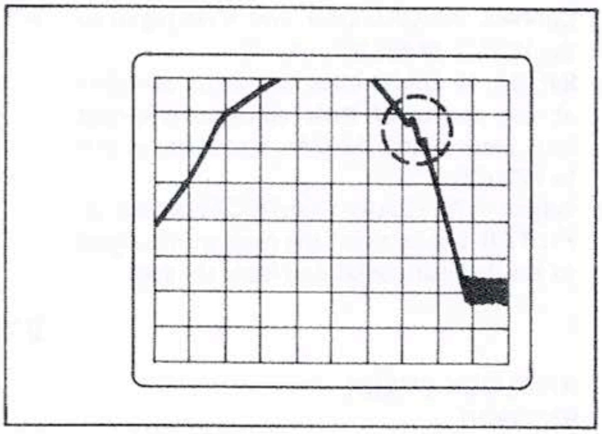


Figure 5.17 1.5 MHz B.P.F. example

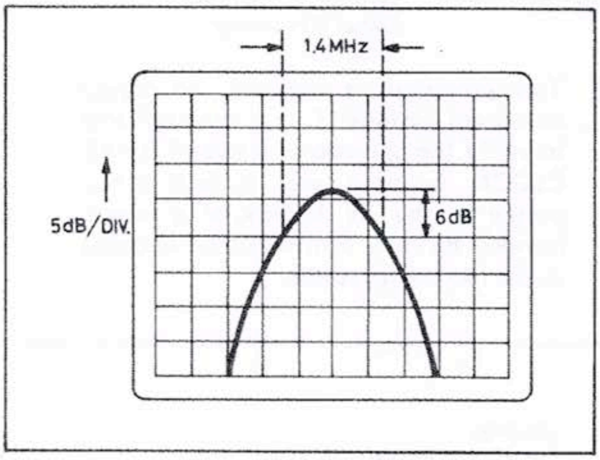


Figure 5.18 B.W. 1.5 MHz

d. Set the Vertical Axis Scale Selector switch to the 5 dB/DIV. position and adjust the outer and inner sections of the IF GAIN switch so that the bandwidth 6 dB below the signal peak can be clearly observed.

e. Reset the outer section of the IF GAIN switch to the 0 dB position and adjust C344 to C347 of the IF FILTER board so that the bandwidth 6 dB below the signal peak is 1.5 MHz ± 0.3 MHz.

5.7.7.5 OVERALL GAIN Adjustment

a. Reset the following front panel controls from the initial settings of Section 5.7.2.2.

DISPERSION/DIV. .... 100 MHz/DIV.
B.W. .... AUTO
IF GAIN .... 0dB, CAL. REFERENCE
R.F. ATT. .... 0dB LEVEL 110dBμ

b. Connect the CAL OUT 100 MHz signal to the INPUT of the instrument.
c. Set the IF GAIN inner and outer switches at the center of their adjustment ranges (e.g. inner switch to CAL and outer switch to +20 dB).
d. Adjust R79 (GAIN CORRECT) on the IF FILTER board to set the peak of the signal to the 3rd horizontal line from the top.

5.7.8 RF BLOCK CHECK (Optional)

Equipment used: Spectrum Analyzer
Signal Generator

NOTE: This procedure is optional, no adjustments are performed. It is intended only to verify the operational status of the RF BLOCK. In most cases, if fault is suspected in the RF BLOCK it is recommended that the instrument be returned to the factory for repair.

5.7.8.1 2nd LOCAL FREQUENCY CHECK

a. Connect the Spectrum Analyzer to the 2nd LO OUTPUT (J46) and verify that the 2nd LO frequency is 1200 MHz ± 3 MHz (Figure 5.19).
b. Disconnect the Spectrum Analyzer and reconnect the 2nd LO cable to (J46).

5.7.8.2 1153.3 MHz BAND PASS FILTER CHECK

a. Connect the Signal Generator output (46.6 MHz at -30 dBμ) to the INPUT of the instrument.
b. Reset the DISPERSION/DIV. switch to the 0.5 MHz/DIV. position and utilize the TUNING control to center the signal on the CRT display.
c. Reconnect the Spectrum Analyzer to the 2nd LO output (J46). The signal on the Spectrum Analyzer will shift as shown in Figure 5.19A. This is the frequency passing characteristics of the 1153.3 MHz Band

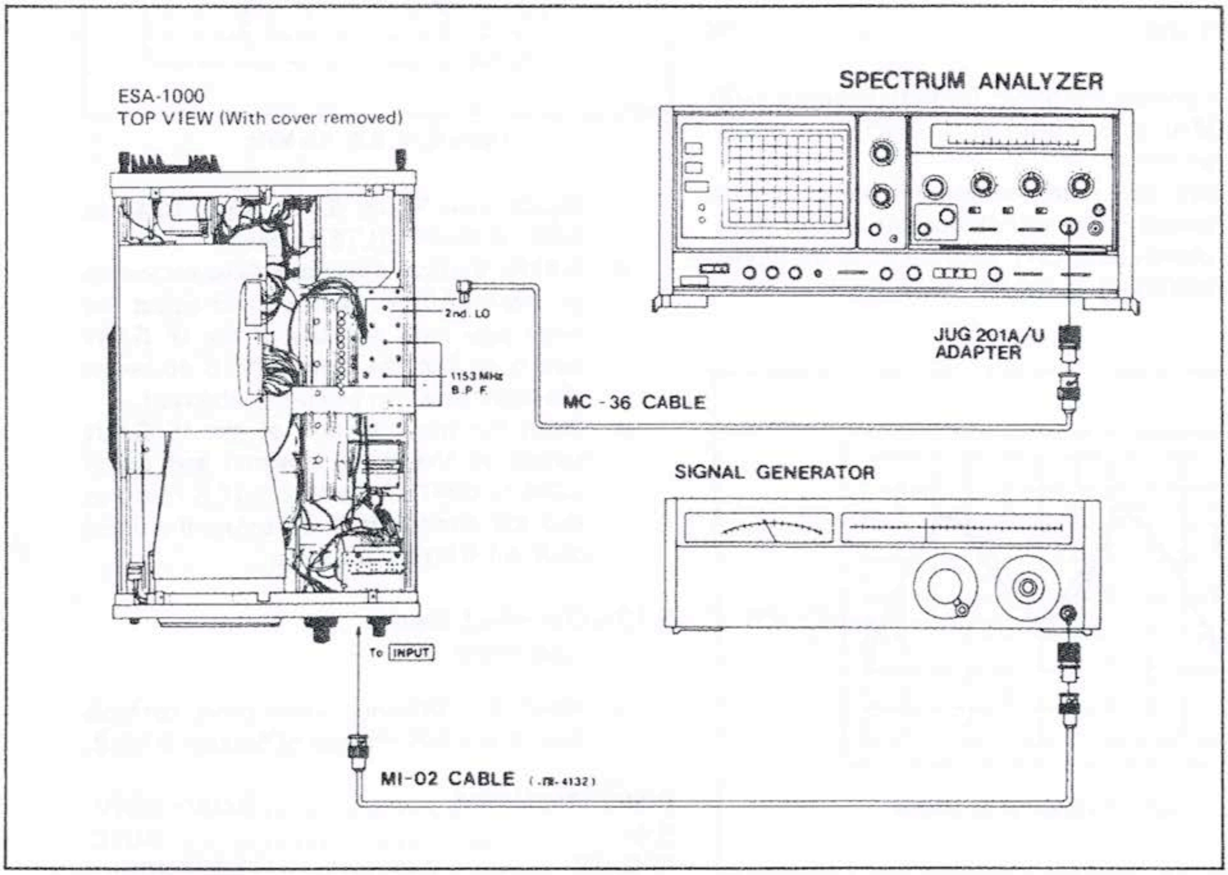


Figure 5.19 RF. Block Check Setup (Optional)

Pass Filter. For easier observation of this signal, set the ESA-1000 SCAN TIME to a slower sweep speed.

d. Set the DISPERSION/DIV. switch of the Spectrum Analyzer to 1 MHz/DIV. and its Vertical Axis Scale Selector switch to 2 dB/DIV. Verify with the Spectrum Analyzer that the bandwidth at 6 dB below the signal peak is more than 2.6 MHz and that the signal is symmetrical from the center point (Figure 5.19B).

e. Reset the DISPERSION/DIV. switch of the ESA-1000 to the ZERO position and center the signal on the Spectrum Analyzer CRT display by use of its TUNING control.

f. Verify that the amplitude level output of the 2nd LO (J46) is between -29 dBμ and -31 dBμ.

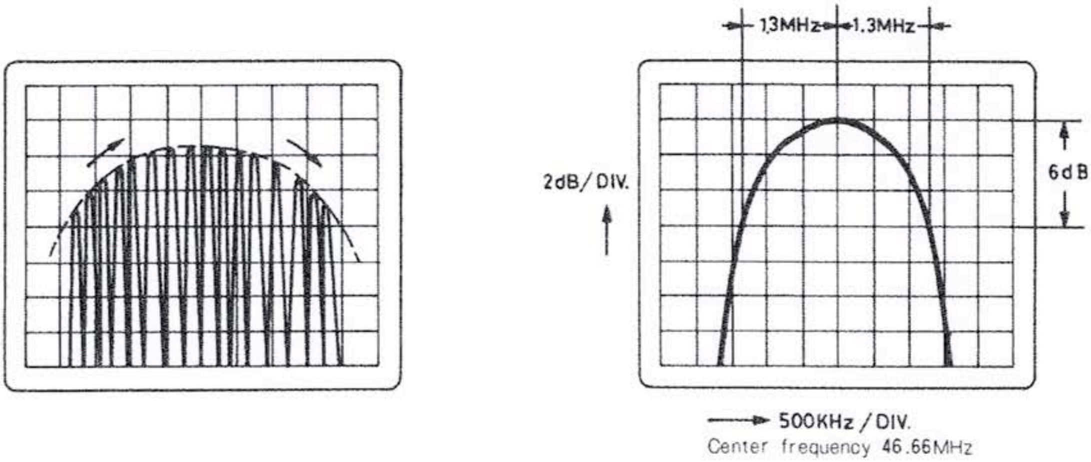


Figure 5.20 B.P.F. Check Display

NOTE: The loss through the RF Block is measured by applying a 46.66 MHz external signal to the RF input of the RF Block. By simultaneously measuring the input 46.66 MHz signal and the resultant 46.66 MHz IF output with a spectrum analyzer, the overall loss of the RF Block is made known.

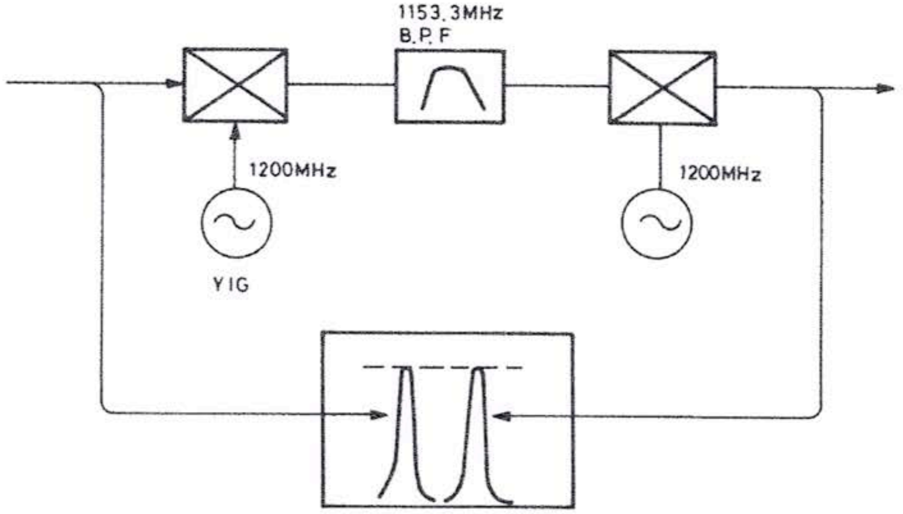
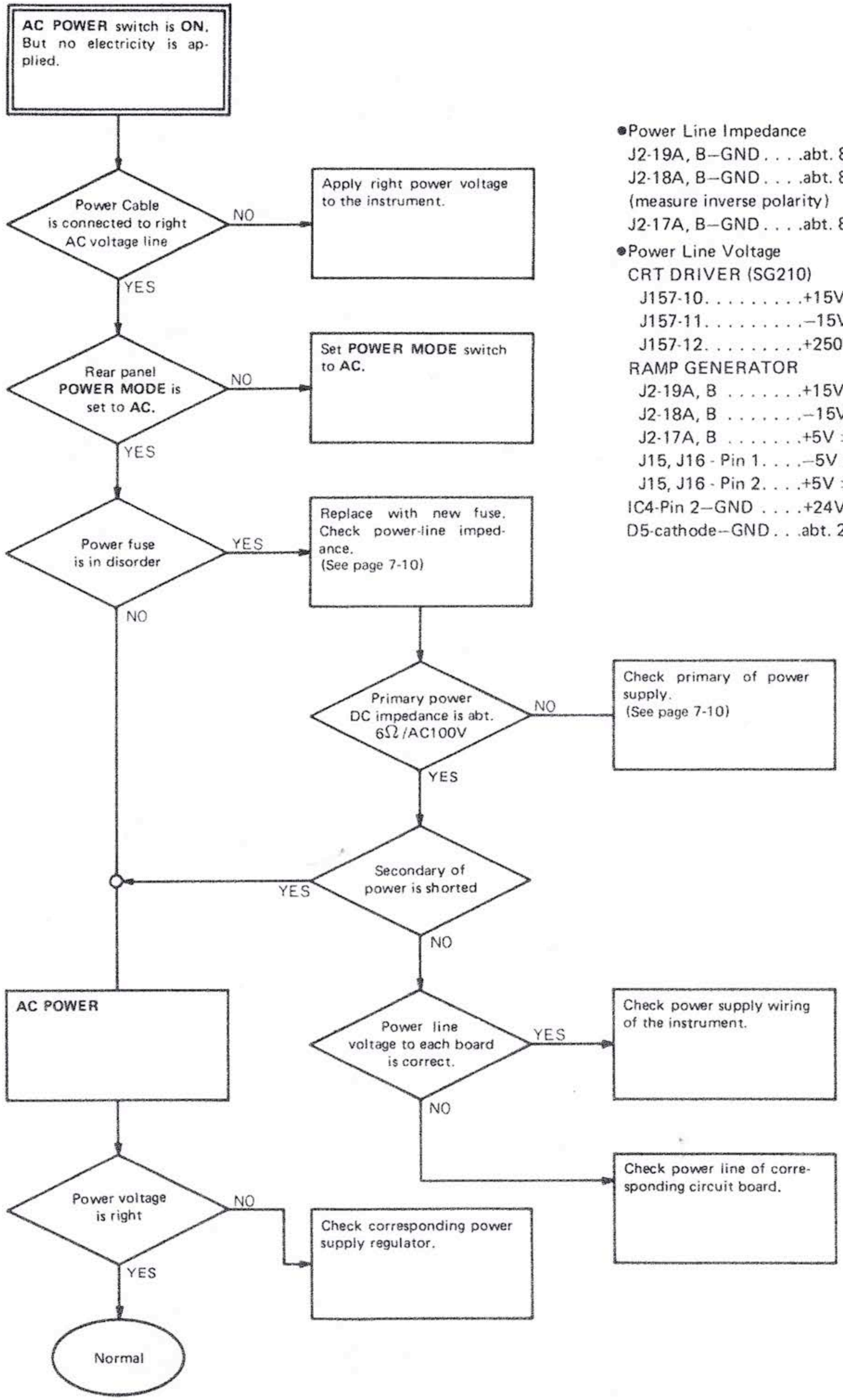
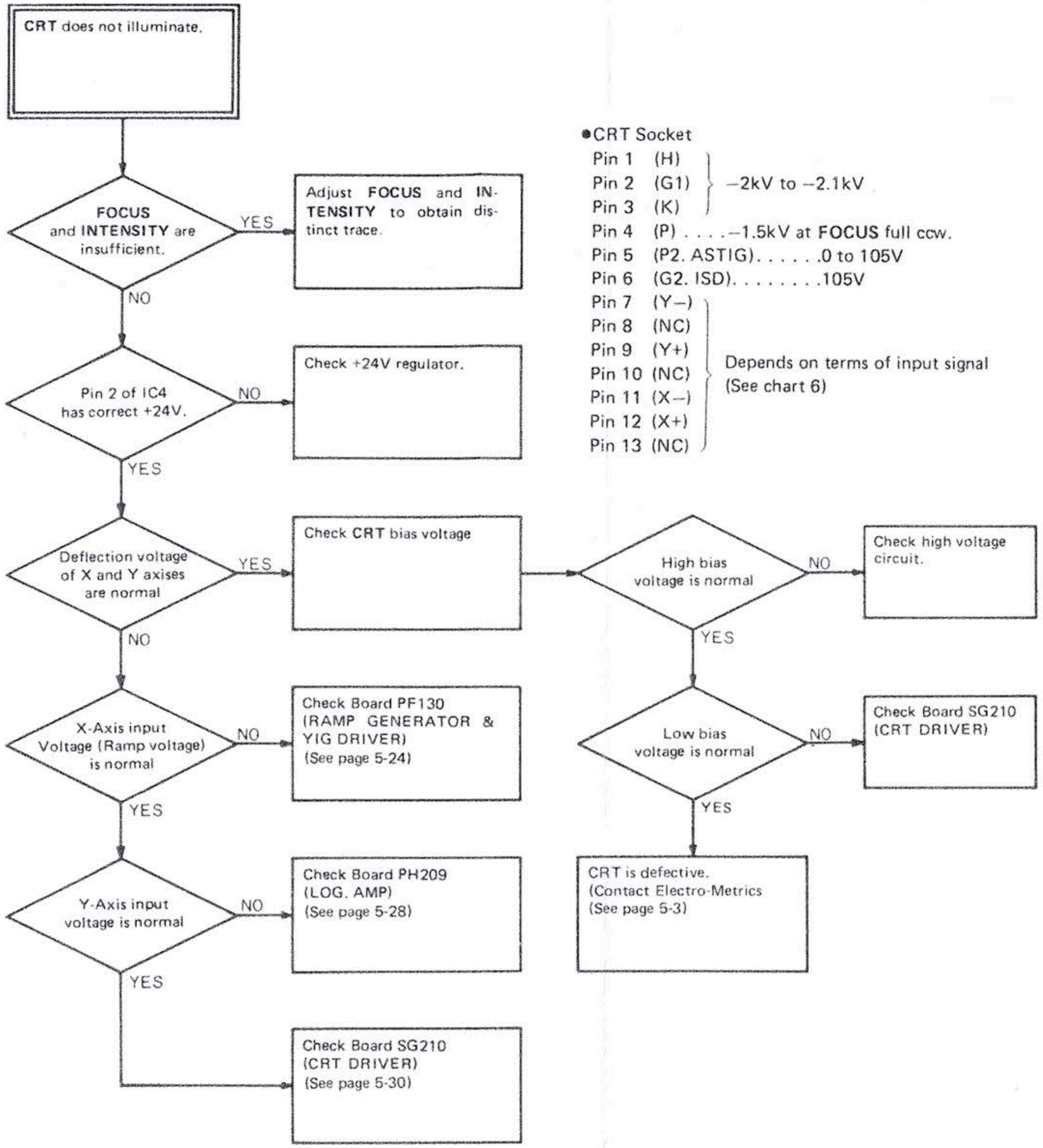


Figure 5.21 RF. BLOCK Loss Measurement


AC POWER switch is ON. But no electricity is applied.
Power Cable is connected to right AC voltage line
NO
Apply right power voltage to the instrument.
YES
Rear panel POWER MODE is set to AC.
NO
Set POWER MODE switch to AC.
YES
Power fuse is in disorder
YES
Replace with new fuse. Check power-line impedance. (See page 7-10)
NO
Primary power DC impedance is abt. 6Ω/AC100V
NO
Check primary of power supply. (See page 7-10)
YES
Secondary of power is shorted
YES
NO
AC POWER
Power line voltage to each board is correct.
YES
Check power supply wiring of the instrument.
NO
Check power line of corresponding circuit board.
Power voltage is right
NO
Check corresponding power supply regulator.
YES
Normal

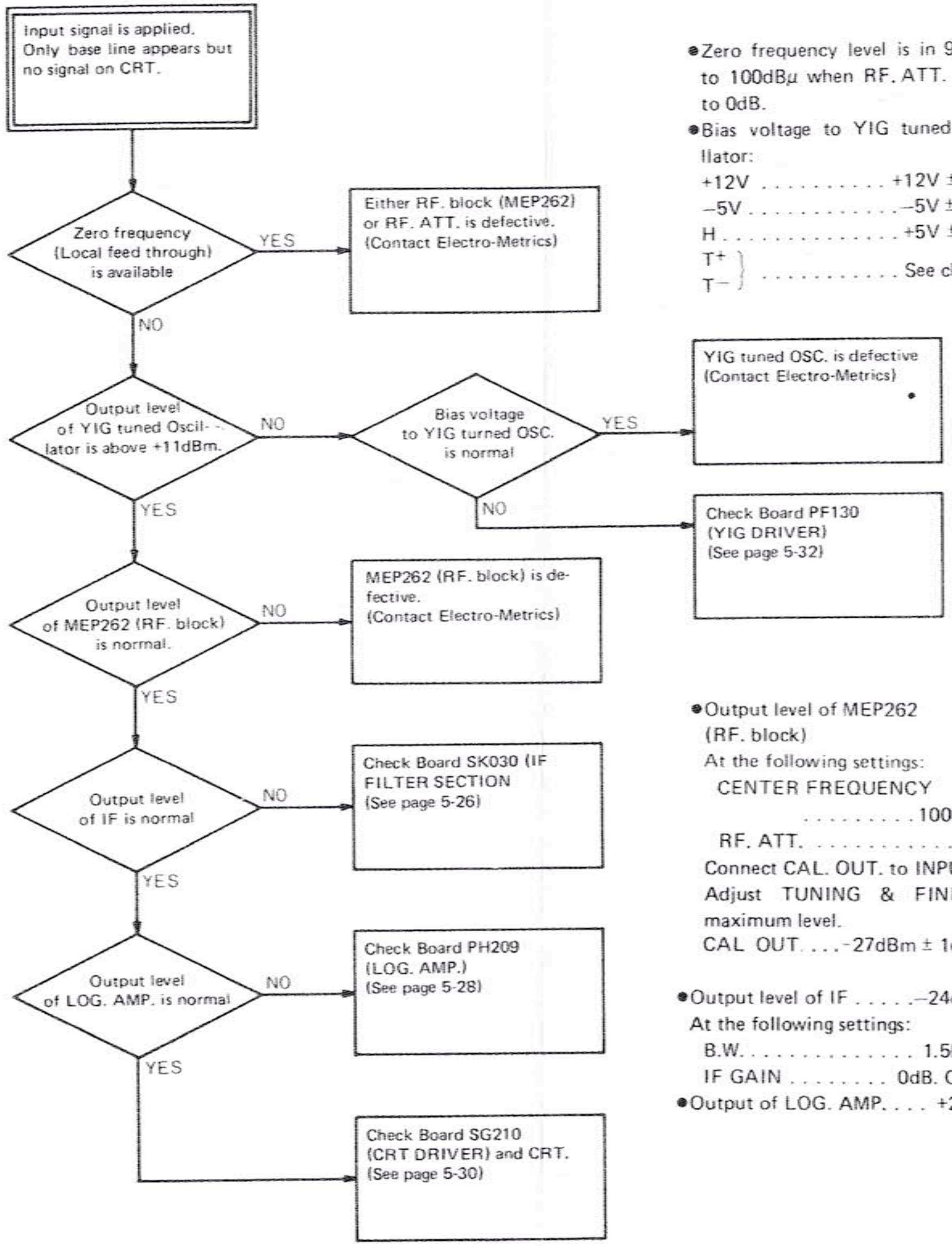
●Power Line Impedance
J2-19A, B–GND . . . .abt. 86Ω to 88Ω
J2-18A, B–GND . . . .abt. 86Ω to 88Ω
(measure inverse polarity)
J2-17A, B–GND . . . .abt. 86Ω to 88Ω

●Power Line Voltage
CRT DRIVER (SG210)
J157-10. . . . .+15V ±0.6V
J157-11. . . . .–15V ±0.6V
J157-12. . . . .+250V
RAMP GENERATOR
J2-19A, B . . . .+15V ±0.6V
J2-18A, B . . . .–15V ±0.6V
J2-17A, B . . . .+5V ±0.2V
J15, J16 - Pin 1. . . .–5V ±0.2V
J15, J16 - Pin 2. . . .+5V ±0.2V
IC4-Pin 2–GND . . . .+24V ±1.2V
D5-cathode–GND . . .abt. 250V


CRT does not illuminate.
FOCUS and INTENSITY are insufficient.
YES
Adjust FOCUS and INTENSITY to obtain distinct trace.
NO
Pin 2 of IC4 has correct +24V.
NO
Check +24V regulator.
YES
Deflection voltage of X and Y axises are normal
YES
Check CRT bias voltage
High bias voltage is normal
NO
Check high voltage circuit.
YES
Low bias voltage is normal
NO
Check Board SG210 (CRT DRIVER)
YES
CRT is defective. (Contact Electro-Metrics (See page 5-3)
NO
X-Axis input Voltage (Ramp voltage) is normal
NO
Check Board PF130 (RAMP GENERATOR & YIG DRIVER) (See page 5-24)
YES
Y-Axis input voltage is normal
NO
Check Board PH209 (LOG. AMP) (See page 5-28)
YES
Check Board SG210 (CRT DRIVER) (See page 5-30)

●CRT Socket
Pin 1 (H)
Pin 2 (G1) } –2kV to –2.1kV
Pin 3 (K)
Pin 4 (P) . . . .–1.5kV at FOCUS full ccw.
Pin 5 (P2. ASTIG). . . . . .0 to 105V
Pin 6 (G2. ISD). 105V
Pin 7 (Y–)
Pin 8 (NC)
Pin 9 (Y+)
Pin 10 (NC) } Depends on terms of input signal (See chart 6)
Pin 11 (X–)
Pin 12 (X+)
Pin 13 (NC)

Figure 5.22
TROUBLESHOOTING CHART 1


Input signal is applied. Only base line appears but no signal on CRT.
Zero frequency (Local feed through) is available
YES
Either RF. block (MEP262) or RF. ATT. is defective. (Contact Electro-Metrics)
NO
Output level of YIG tuned Oscil-lator is above +11dBm.
NO
Bias voltage to YIG turned OSC. is normal
YES
YIG tuned OSC. is defective (Contact Electro-Metrics)
NO
Check Board PF130 (YIG DRIVER) (See page 5-32)
YES
Output level of MEP262 (RF. block) is normal.
NO
MEP262 (RF. block) is de-fective. (Contact Electro-Metrics)
YES
Output level of IF is normal
NO
Check Board SK030 (IF FILTER SECTION (See page 5-26)
YES
Output level of LOG. AMP. is normal
NO
Check Board PH209 (LOG. AMP.) (See page 5-28)
YES
Check Board SG210 (CRT DRIVER) and CRT. (See page 5-30)

- Zero frequency level is in 90dBμ to 100dBμ when RF. ATT. is set to 0dB.
- Bias voltage to YIG tuned oscillator:

+12V . . . . +12V ±0.6V
–5V . . . . –5V ±0.2V
H . . . . +5V ±0.6V
T+ }
T– } . . . . See chart 3

- Output level of MEP262 (RF. block)

At the following settings:
CENTER FREQUENCY 100MHz
RF. ATT. 0dB
Connect CAL. OUT. to INPUT.
Adjust TUNING & FINE for maximum level.
CAL OUT. . . . -27dBm ± 1dBm

- Output level of IF . . . . . –24dBm

At the following settings:
B.W. 1.5MHz
IF GAIN . . . . 0dB. CAL.

- Output of LOG. AMP. . . . +2.5V

Figure 5.23
TROUBLESHOOTING CHART 2

BOARD PF130 – RAMP GENERATOR & YIG DRIVER

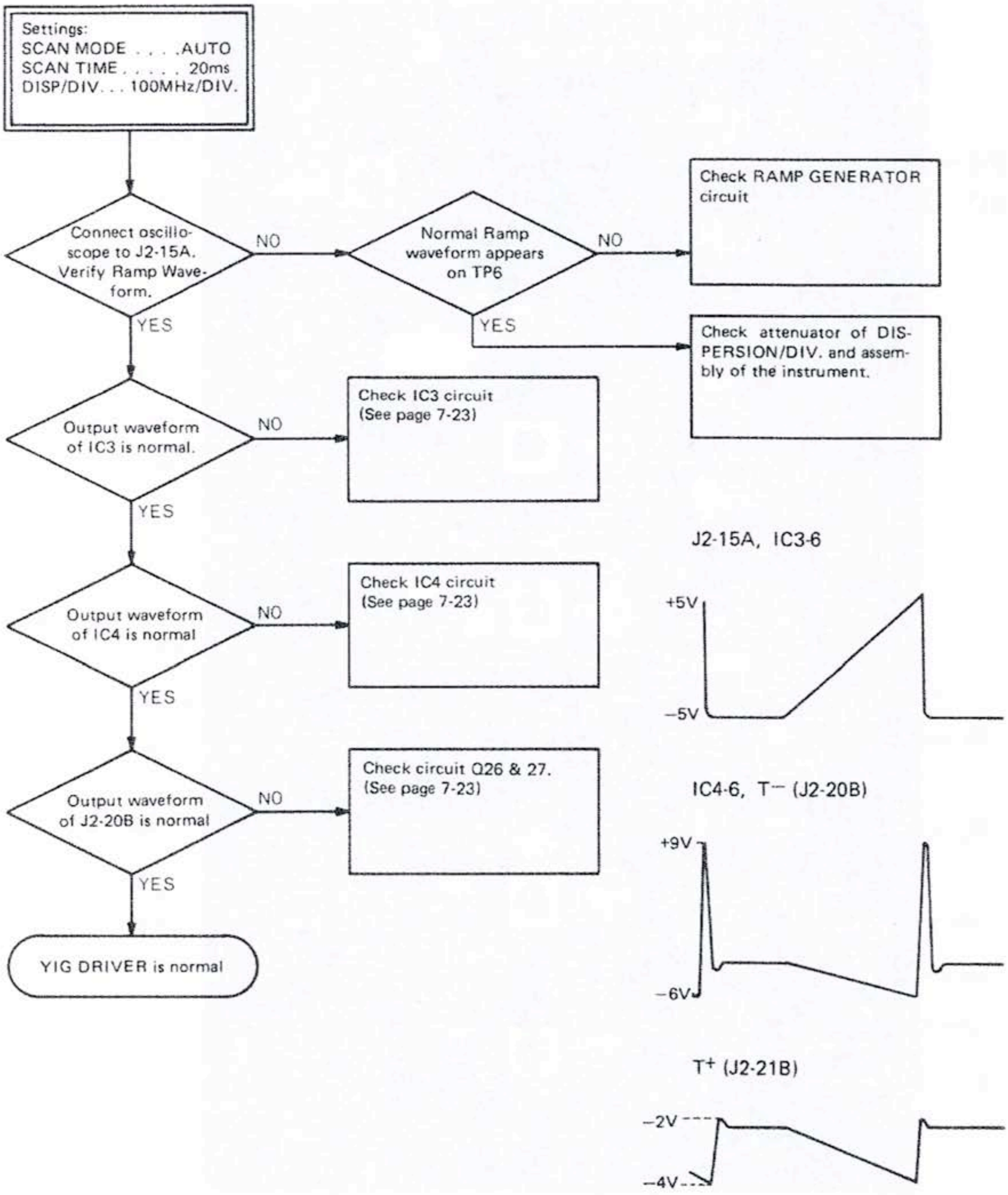
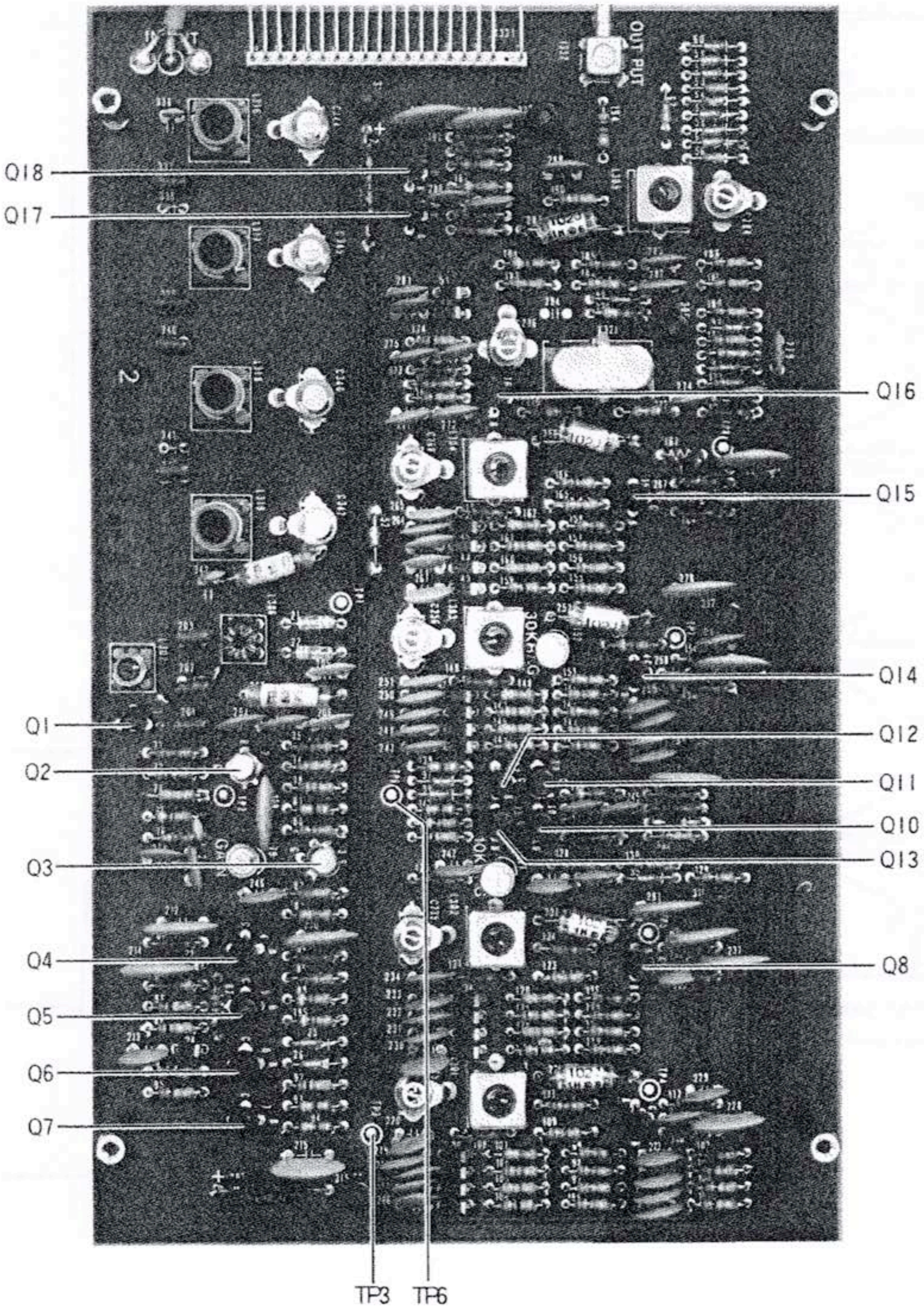

Settings:
SCAN MODE . . . .AUTO
SCAN TIME 20ms
DISP/DIV. . . 100MHz/DIV.
Connect oscilloscope to J2-15A. Verify Ramp Waveform.
NO
Normal Ramp waveform appears on TP6
NO
Check RAMP GENERATOR circuit
YES
Check attenuator of DISPERSION/DIV. and assembly of the instrument.
YES
Output waveform of IC3 is normal.
NO
Check IC3 circuit (See page 7-23)
YES
Output waveform of IC4 is normal
NO
Check IC4 circuit (See page 7-23)
YES
Output waveform of J2-20B is normal
NO
Check circuit Q26 & 27. (See page 7-23)
YES
YIG DRIVER is normal
J2-15A, IC3-6
+5V
–5V
IC4-6, T⁻ (J2-20B)
+9V
–6V
T⁺ (J2-21B)
–2V
–4V

Figure 5.24
TROUBLESHOOTING CHART 3



Q18
Q17
Q16
Q15
Q14
Q1
Q12
Q2
Q11
Q10
Q3
Q13
Q4
Q8
Q5
Q6
Q7
TP3
TP6
OUT PUT

Figure 5.25 IF FILTER (SK030) CHECK POINTS

BOARD SK030 IF FILTER

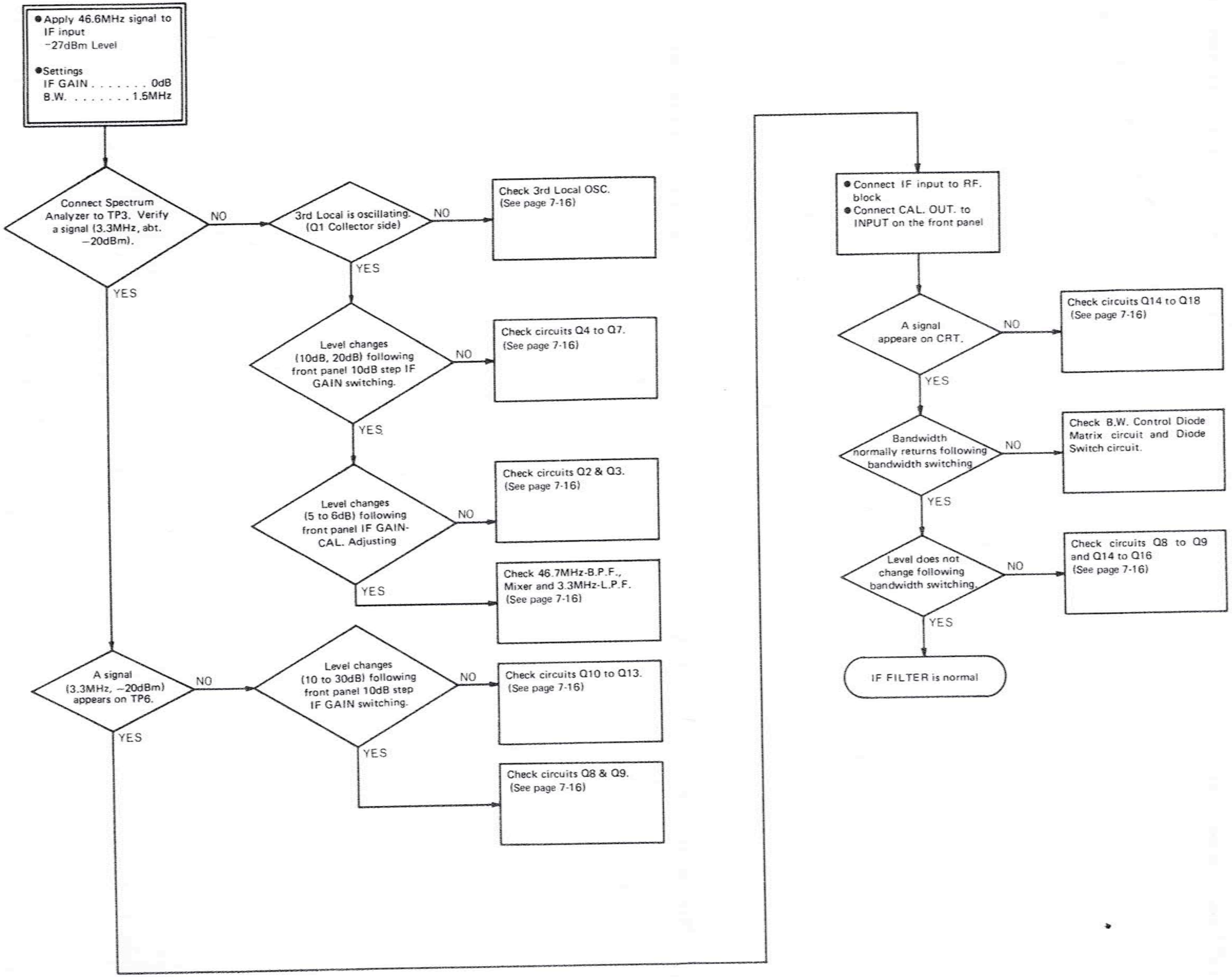
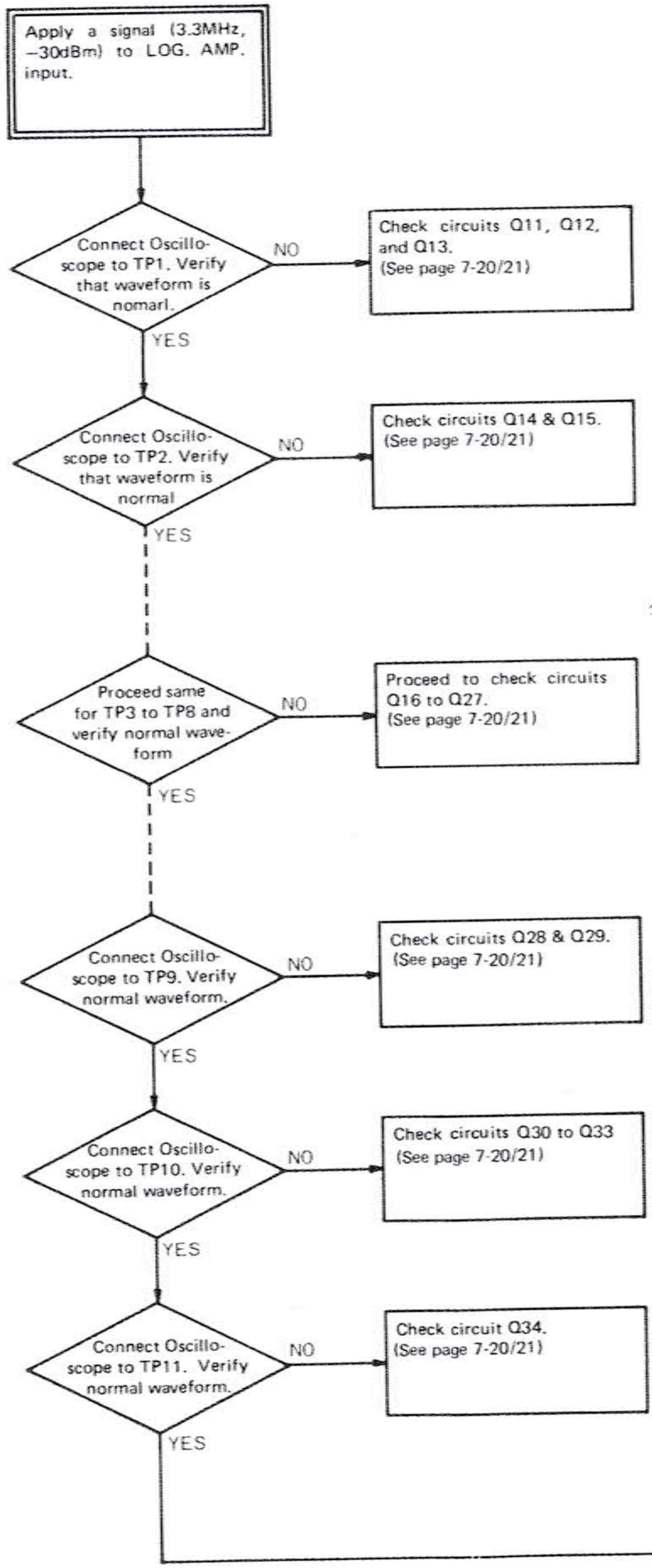
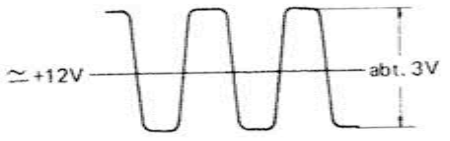

●Apply 46.6MHz signal to IF input −27dBm Level
●Settings
IF GAIN 0dB
B.W. 1.5MHz
Connect Spectrum Analyzer to TP3. Verify a signal (3.3MHz, abt. −20dBm).
NO
YES
3rd Local is oscillating. (Q1 Collector side)
NO
YES
Check 3rd Local OSC. (See page 7-16)
Level changes (10dB, 20dB) following front panel 10dB step IF GAIN switching.
NO
YES
Check circuits Q4 to Q7. (See page 7-16)
Level changes (5 to 6dB) following front panel IF GAIN-CAL. Adjusting
NO
YES
Check circuits Q2 & Q3. (See page 7-16)
Check 46.7MHz-B.P.F., Mixer and 3.3MHz-L.P.F. (See page 7-16)
A signal (3.3MHz, −20dBm) appears on TP6.
NO
YES
Level changes (10 to 30dB) following front panel 10dB step IF GAIN switching.
NO
YES
Check circuits Q10 to Q13. (See page 7-16)
Check circuits Q8 & Q9. (See page 7-16)
●Connect IF input to RF. block
●Connect CAL. OUT. to INPUT on the front panel
A signal appeare on CRT.
NO
YES
Check circuits Q14 to Q18 (See page 7-16)
Bandwidth normally returns following bandwidth switching
NO
YES
Check B.W. Control Diode Matrix circuit and Diode Switch circuit.
Level does not change following bandwidth switching.
NO
YES
Check circuits Q8 to Q9 and Q14 to Q16 (See page 7-16)
IF FILTER is normal

Figure 5.26
TROUBLESHOOTING CHART 4

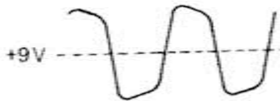
BOARD PH209 LOG. AMP.


Apply a signal (3.3MHz, –30dBm) to LOG. AMP. input.
Connect Oscillo-scope to TP1. Verify that waveform is nomarl.
NO
Check circuits Q11, Q12, and Q13. (See page 7-20/21)
YES
Connect Oscillo-scope to TP2. Verify that waveform is normal
NO
Check circuits Q14 & Q15. (See page 7-20/21)
YES
Proceed same for TP3 to TP8 and verify normal wave-form
NO
Proceed to check circuits Q16 to Q27. (See page 7-20/21)
YES
Connect Oscillo-scope to TP9. Verify normal waveform.
NO
Check circuits Q28 & Q29. (See page 7-20/21)
YES
Connect Oscillo-scope to TP10. Verify normal waveform.
NO
Check circuits Q30 to Q33 (See page 7-20/21)
YES
Connect Oscillo-scope to TP11. Verify normal waveform.
NO
Check circuit Q34. (See page 7-20/21)
YES

- TP1 Normal waveform
  60mVp-p Sine wave
  Offset +12V
- TP2 Normal waveform
  190mVp-p Sine wave
  Offset +12V
- TP3 Normal waveform
  60mVp-p Sine wave
  Offset +12V
- TP4 Normal waveform
  Abt. 2Vp-p Sine wave
  Offset +12V
- TP5 to TP9 Normal waveform

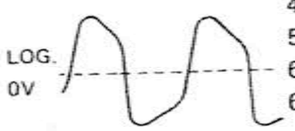


- TP10 Normal waveform



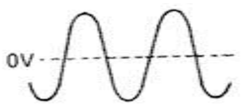
230mVp-p/Input –30dBm
270mVp-p/Input –20dBm
310mVp-p/Input –10dBm
350mVp-p/Input 0dBm

- TP11 Normal waveform

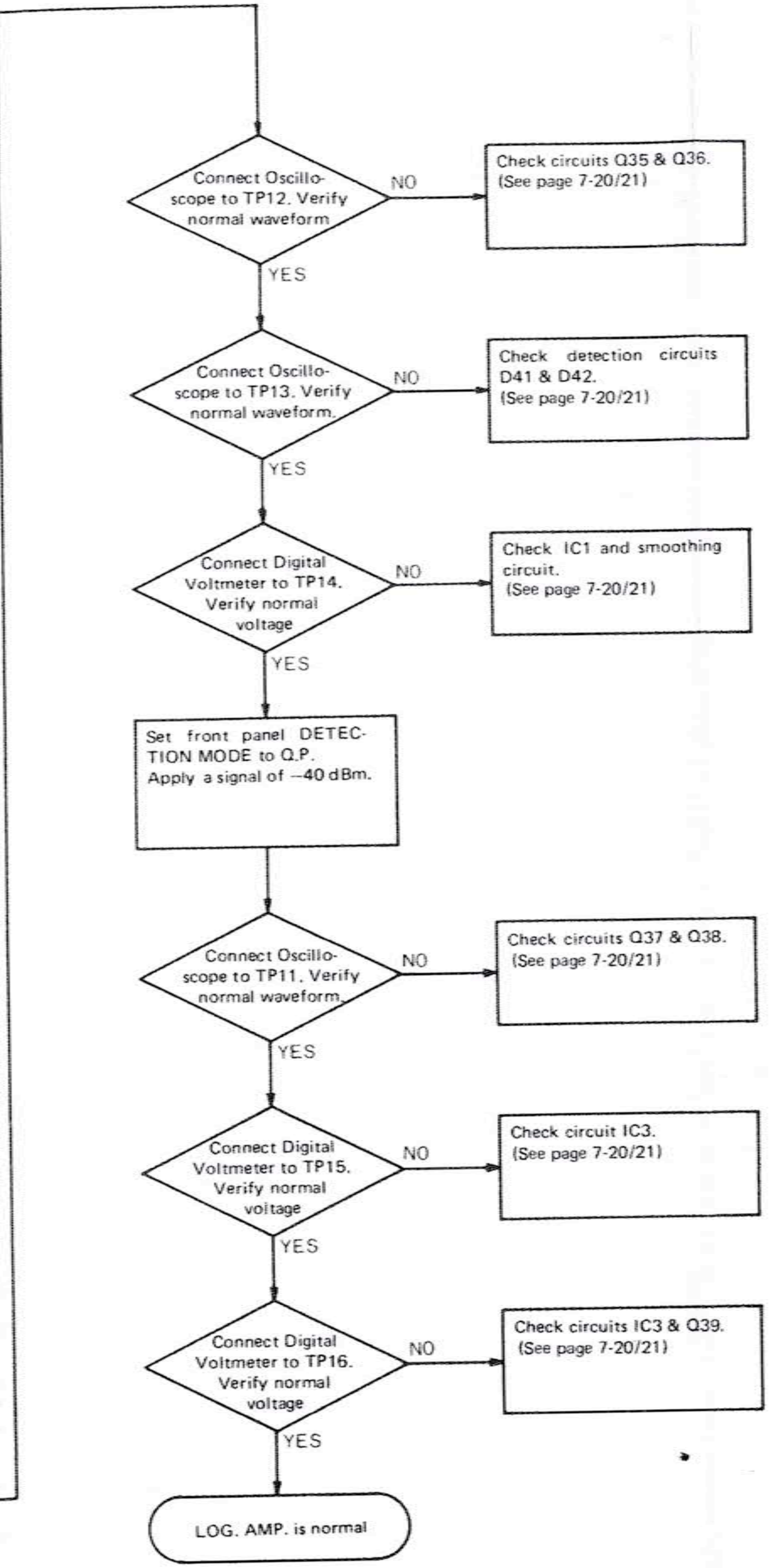


440mVp-p/Input –30dBm
520mVp-p/Input –20dBm
600mVp-p/Input –10dBm
680mVp-p/Input 0dBm

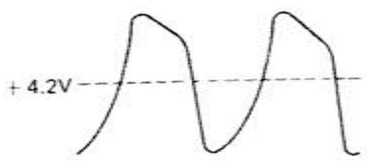
If front panel is set to LIN. or Q.P.: –



560mVp-p/Input –40dBm
180mVp-p/Input –50dBm
56mVp-p/Input –60dBm

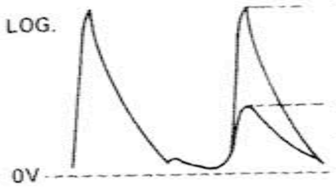

Connect Oscillo-scope to TP12. Verify normal waveform
NO
Check circuits Q35 & Q36. (See page 7-20/21)
YES
Connect Oscillo-scope to TP13. Verify normal waveform.
NO
Check detection circuits D41 & D42. (See page 7-20/21)
YES
Connect Digital Voltmeter to TP14. Verify normal voltage
NO
Check IC1 and smoothing circuit. (See page 7-20/21)
YES
Set front panel DETECTION MODE to Q.P. Apply a signal of –40 dBm.
Connect Oscillo-scope to TP11. Verify normal waveform.
NO
Check circuits Q37 & Q38. (See page 7-20/21)
YES
Connect Digital Voltmeter to TP15. Verify normal voltage
NO
Check circuit IC3. (See page 7-20/21)
YES
Connect Digital Voltmeter to TP16. Verify normal voltage
NO
Check circuits IC3 & Q39. (See page 7-20/21)
YES
LOG. AMP. is normal

- TP12 Waveform



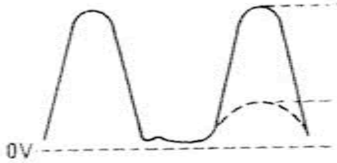
5.8Vp-p/Input –30dBm
6.6Vp-p/Input –20dBm
7.4Vp-p/Input –10dBm
8.0Vp-p/Input 0dBm

- TP13 Waveform



+270mVp-p/Input –30dBm
+120mVp-p/Input –60dBm
+310mVp-p/Input –20dBm
+340mVp-p/Input –10dBm

If front panel is set to LIN. or Q.P.:



+270mVp-p/Input –40dBm
+90mVp-p/Input –50dBm

- TP14 Voltage

Input Signal Level	TP14 Voltage
0dBm	4.0V
–10dBm	3.5V
–20dBm	3.0V
–30dBm	2.5V
–40dBm	2.0V
–50dBm	1.5V
–60dBm	1.0V
–70dBm	0.5V
–80dBm	0V

- TP15 Voltage (when set to Q.P.)

Input Signal Level	TP15 Voltage
–40dBm	4.0V
–50dBm	1.3V
–60dBm	0.4V
–70dBm	0.13V
–80dBm	0.04V

- TP16 Voltage (when set to Q.P.)

Input Signal Level	TP16 Voltage
–40dBm	4.0V
–50dBm	3.5V
–60dBm	3.0V
–70dBm	2.5V
–80dBm	2.0V

Figure 5.28
TROUBLE-SHOOTING CHART 5

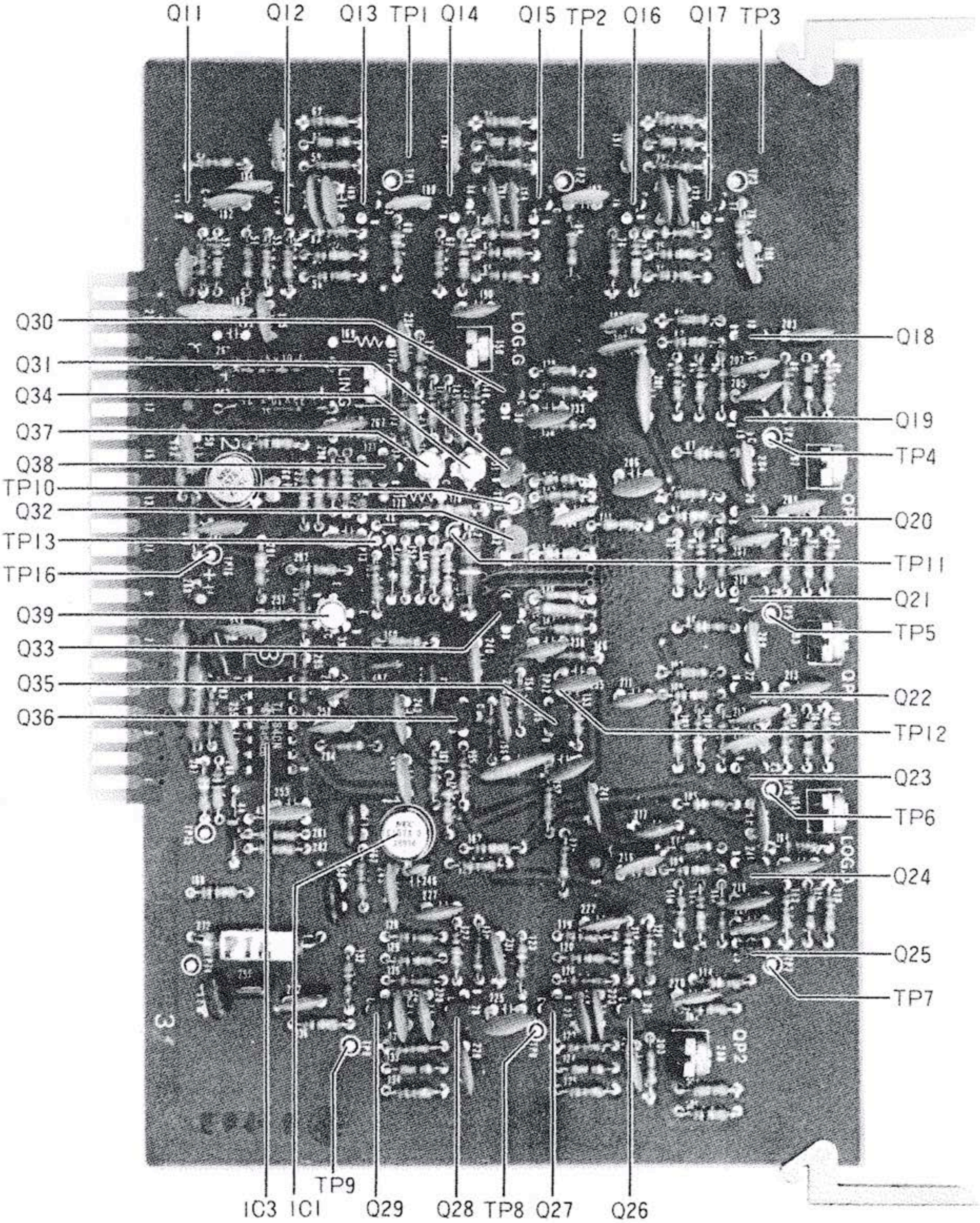

Q11
Q12
Q13
TP1
Q14
Q15
TP2
Q16
Q17
TP3
Q30
Q31
Q34
Q37
Q38
TP10
Q32
TP13
TP16
Q39
Q33
Q35
Q36
Q18
Q19
TP4
Q20
TP11
Q21
TP5
Q22
TP12
Q23
TP6
Q24
Q25
TP7
TP9
IC3
IC1
Q29
Q28
TP8
Q27
Q26
LOG.G
LIN.G

Figure 5.27 LOG AMP (PH209) CHECK POINTS

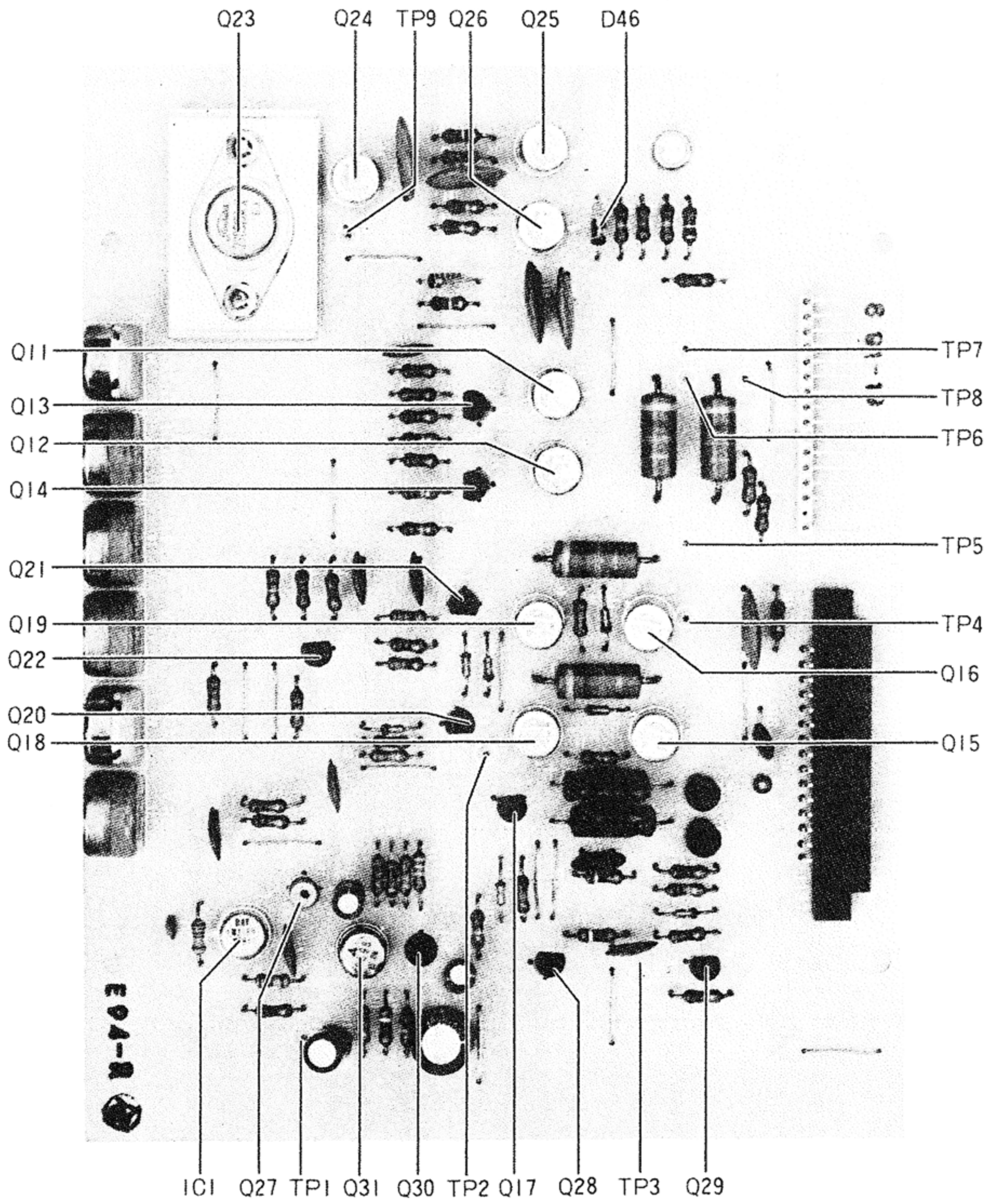
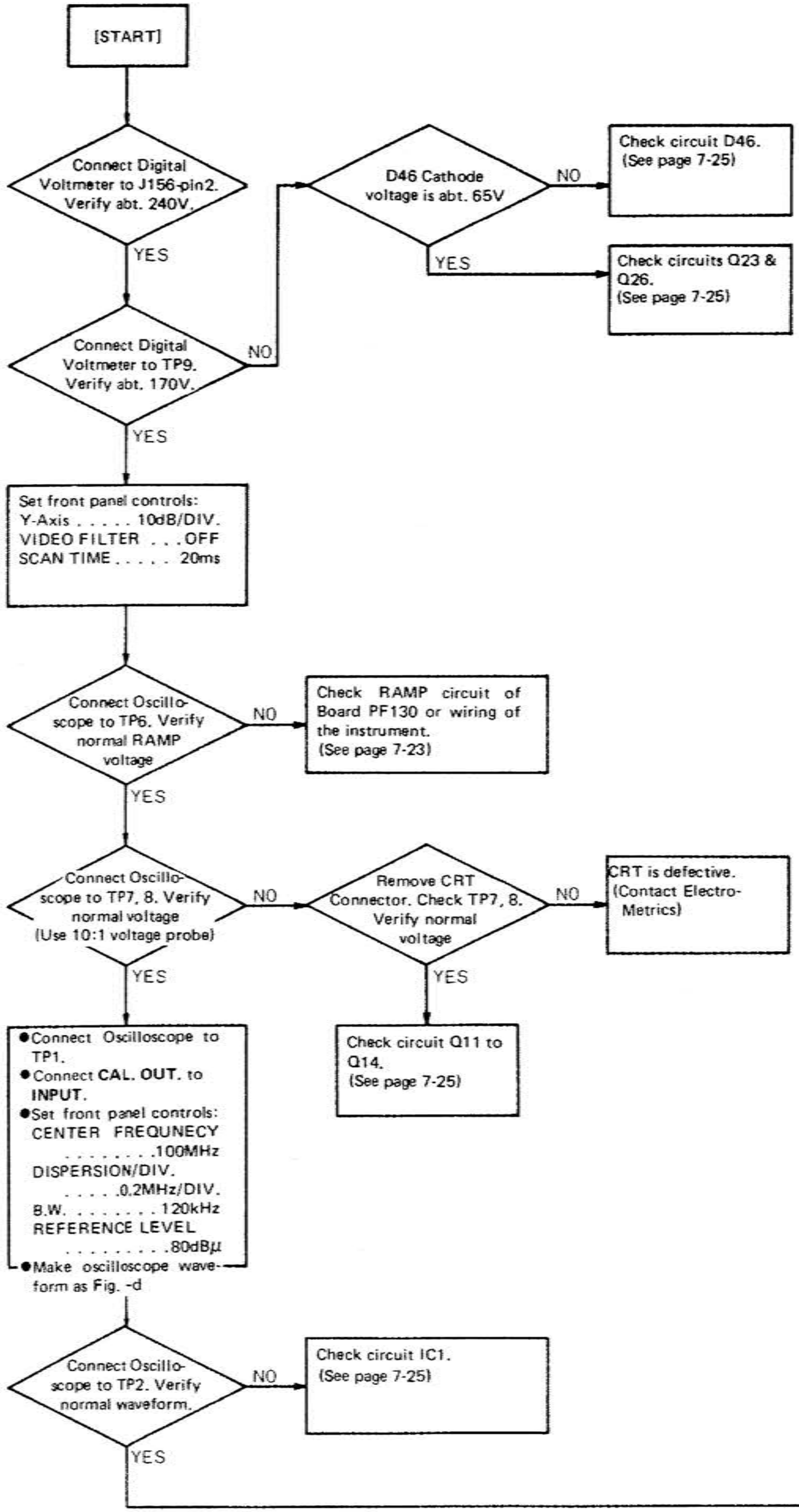
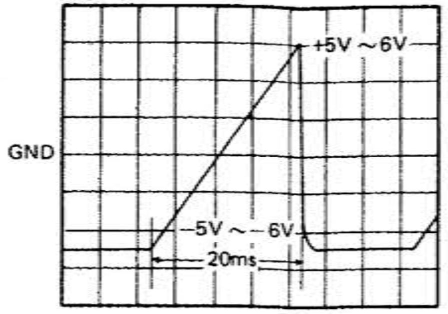

Q23
Q24
TP9
Q26
Q25
D46
Q11
Q13
Q12
Q14
Q21
Q19
Q22
Q20
Q18
TP7
TP8
TP6
TP5
TP4
Q16
Q15
IC1
Q27
TP1
Q31
Q30
TP2
Q17
Q28
TP3
Q29

Figure 5.29 CRT DRIVER (SG210) CHECK POINTS

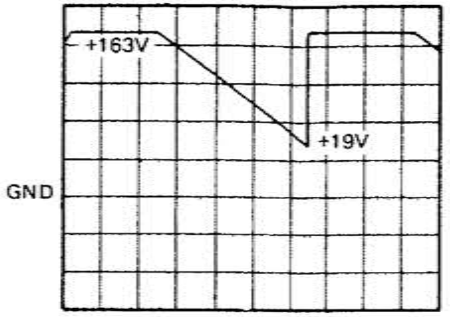
BOARD SG210 CRT DRIVER


[START]
Connect Digital Voltmeter to J156-pin2. Verify abt. 240V.
YES
NO
D46 Cathode voltage is abt. 65V
NO
Check circuit D46. (See page 7-25)
YES
Check circuits Q23 & Q26. (See page 7-25)
Connect Digital Voltmeter to TP9. Verify abt. 170V.
NO
YES
Set front panel controls: Y-Axis . . . . . 10dB/DIV. VIDEO FILTER . . . OFF SCAN TIME 20ms
Connect Oscilloscope to TP6. Verify normal RAMP voltage
NO
Check RAMP circuit of Board PF130 or wiring of the instrument. (See page 7-23)
YES
Connect Oscilloscope to TP7, 8. Verify normal voltage (Use 10:1 voltage probe)
NO
Remove CRT Connector. Check TP7, 8. Verify normal voltage
NO
CRT is defective. (Contact Electro-Metrics)
YES
YES
Check circuit Q11 to Q14. (See page 7-25)
●Connect Oscilloscope to TP1.
●Connect CAL. OUT. to INPUT.
●Set front panel controls: CENTER FREQUNECY . . . . .100MHz DISPERSION/DIV. . . . . .0.2MHz/DIV. B.W. . . . . 120kHz REFERENCE LEVEL 80dBμ
●Make oscilloscope waveform as Fig. -d
Connect Oscilloscope to TP2. Verify normal waveform.
NO
Check circuit IC1. (See page 7-25)
YES

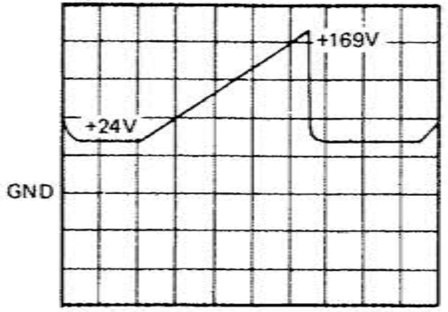
Fig–a TP6 Waveform



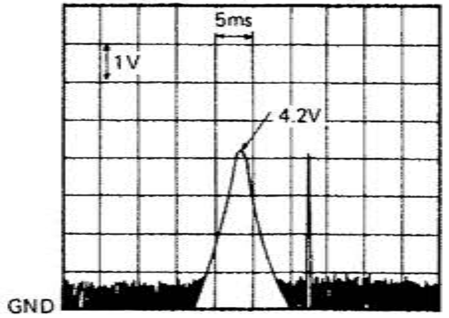
Fig–b TP7 Waveform



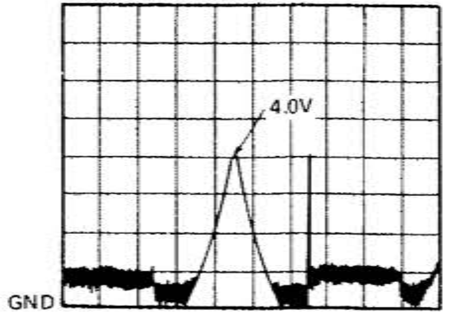
Fig–c TP8 Waveform

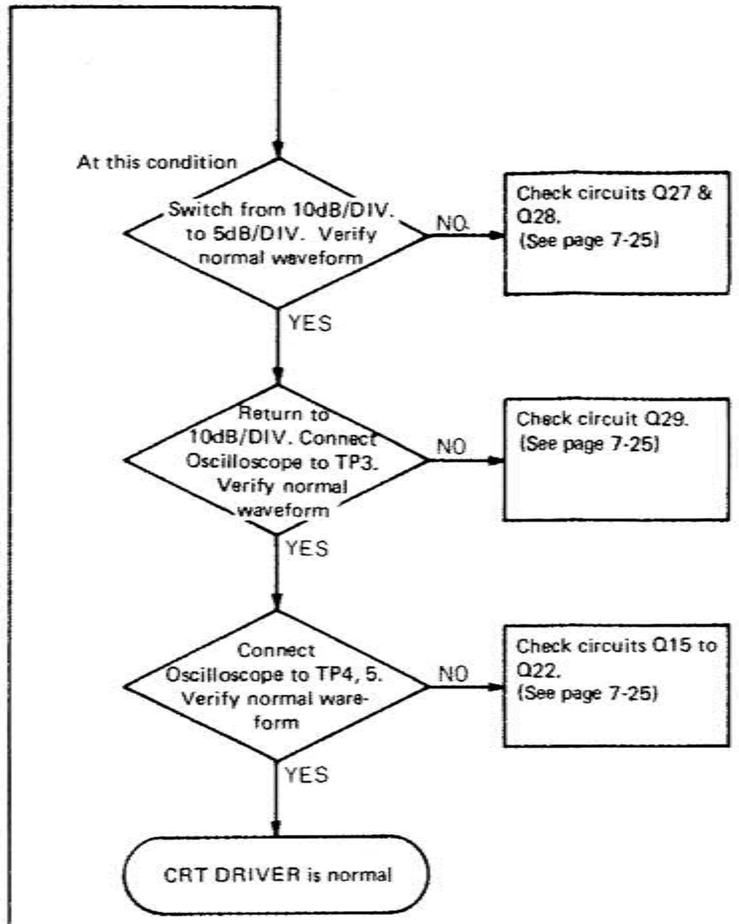


Fig–d TP1 Waveform
(1V/DIV., 5ms/DIV.)

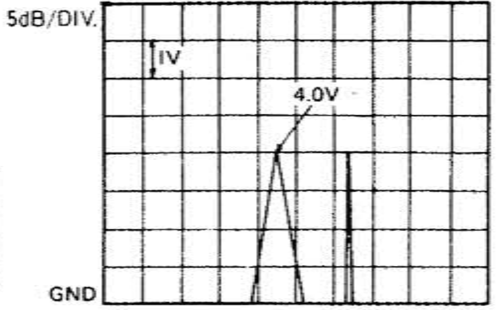


Fig–e TP2 Waveform

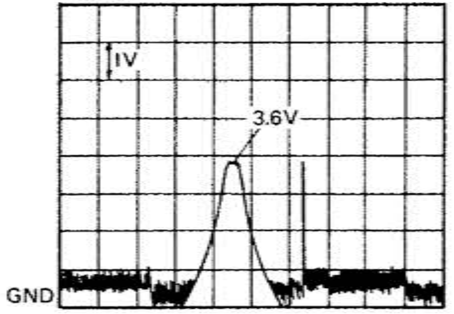



At this condition
Switch from 10dB/DIV. to 5dB/DIV. Verify normal waveform
NO
Check circuits Q27 & Q28. (See page 7-25)
YES
Return to 10dB/DIV. Connect Oscilloscope to TP3. Verify normal waveform
NO
Check circuit Q29. (See page 7-25)
YES
Connect Oscilloscope to TP4, 5. Verify normal waveform
NO
Check circuits Q15 to Q22. (See page 7-25)
YES
CRT DRIVER is normal

Fig–f TP2 Waveform



Fig–g TP3 Waveform



Fig–h TP4 Waveform

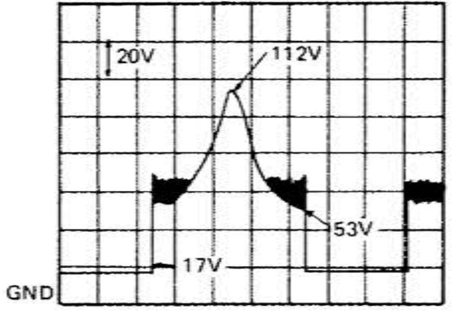


Fig-i TP5 Waveform

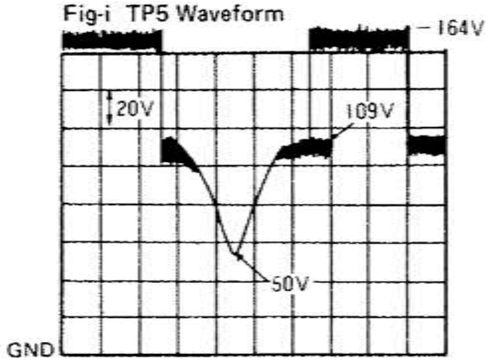


Fig-j

DISPERSION/DIV. . . . . . .0.2MHz/DIV.
B.W. 120kHz
IF GAIN 30dB
SCAN TIME 20ms

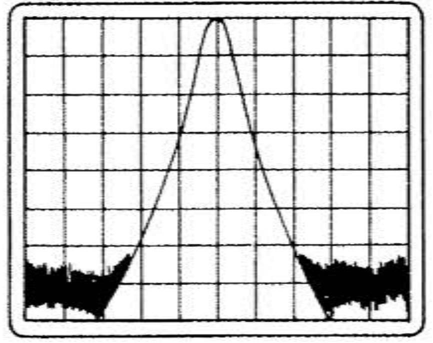
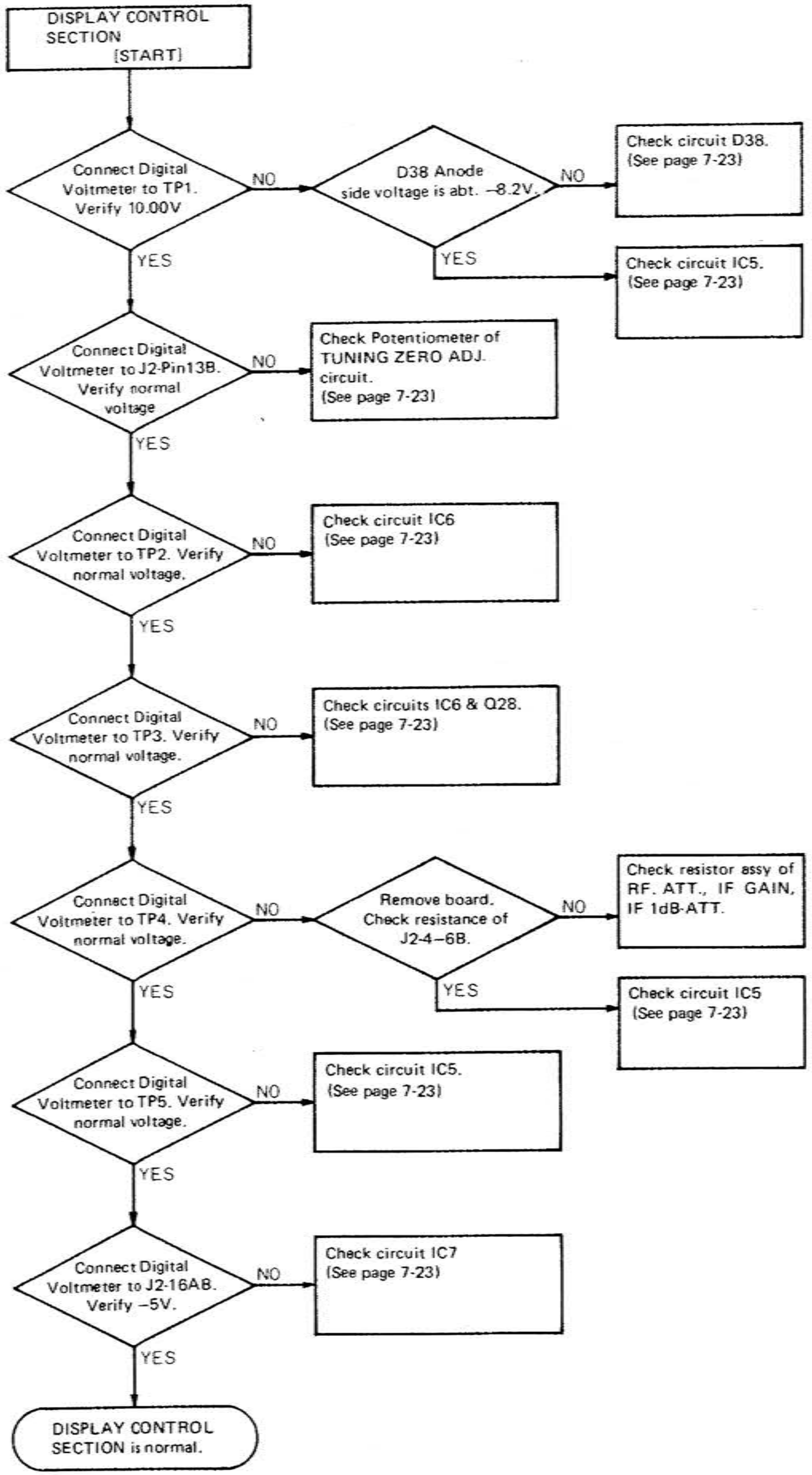


Figure 5.30
TROUBLESHOOTING CHART 6

BOARD PF130 RAMP GENERATOR, YIG DRIVER & DISPLAY CONTROL


DISPLAY CONTROL SECTION [START]
Connect Digital Voltmeter to TP1. Verify 10.00V
NO
D38 Anode side voltage is abt. –8.2V.
NO
Check circuit D38. (See page 7-23)
YES
Check circuit IC5. (See page 7-23)
YES
Connect Digital Voltmeter to J2-Pin13B. Verify normal voltage
NO
Check Potentiometer of TUNING ZERO ADJ. circuit. (See page 7-23)
YES
Connect Digital Voltmeter to TP2. Verify normal voltage.
NO
Check circuit IC6 (See page 7-23)
YES
Connect Digital Voltmeter to TP3. Verify normal voltage.
NO
Check circuits IC6 & Q28. (See page 7-23)
YES
Connect Digital Voltmeter to TP4. Verify normal voltage.
NO
Remove board. Check resistance of J2-4–6B.
NO
Check resistor assy of RF. ATT., IF GAIN, IF 1dB-ATT.
YES
Check circuit IC5 (See page 7-23)
YES
Connect Digital Voltmeter to TP5. Verify normal voltage.
NO
Check circuit IC5. (See page 7-23)
YES
Connect Digital Voltmeter to J2-16AB. Verify –5V.
NO
Check circuit IC7 (See page 7-23)
YES
DISPLAY CONTROL SECTION is normal.

●TP1 +10.00V DC

●J2-13B **TUNING** full ccw[*1] abt. –2.7V

TUNING full cw[*2] abt. –5.8V

●TP2 **TUNING** full ccw abt. –1V

TUNING full cw abt. +11V

●TP3 At the neighbour of **CENTER FREQUENCY** 0MHz, rapidly changes in abt. +8V to abt. +1V. Thereafter becomes 0.0V at 34MHz and indicates –1.55V at 1000MHz.

When switching front panel control from ANT. A to ANT. B, it shows 0.25V (both -***TR*-4132** & -***TR*-4132N**).

●TP4

REF. LEVEL	TP4 Voltage
80dBμ	–4.0V
90dBμ	–4.5V
100dBμ	–5.0V
110dBμ	–5.5V
120dBμ	–6.0V
130dBμ	–6.5V
140dBμ	–7.0V
150dBμ	–7.5V

*Front panel settings:
RF. ATT 0dB
IF GAIN . . . . . 0dB, CAL.
REFERENCE LEVEL
. . . . . INPUT LEVEL

●TP5 **Corresponde to REFERENCE LEVEL** display at 1 : 1.

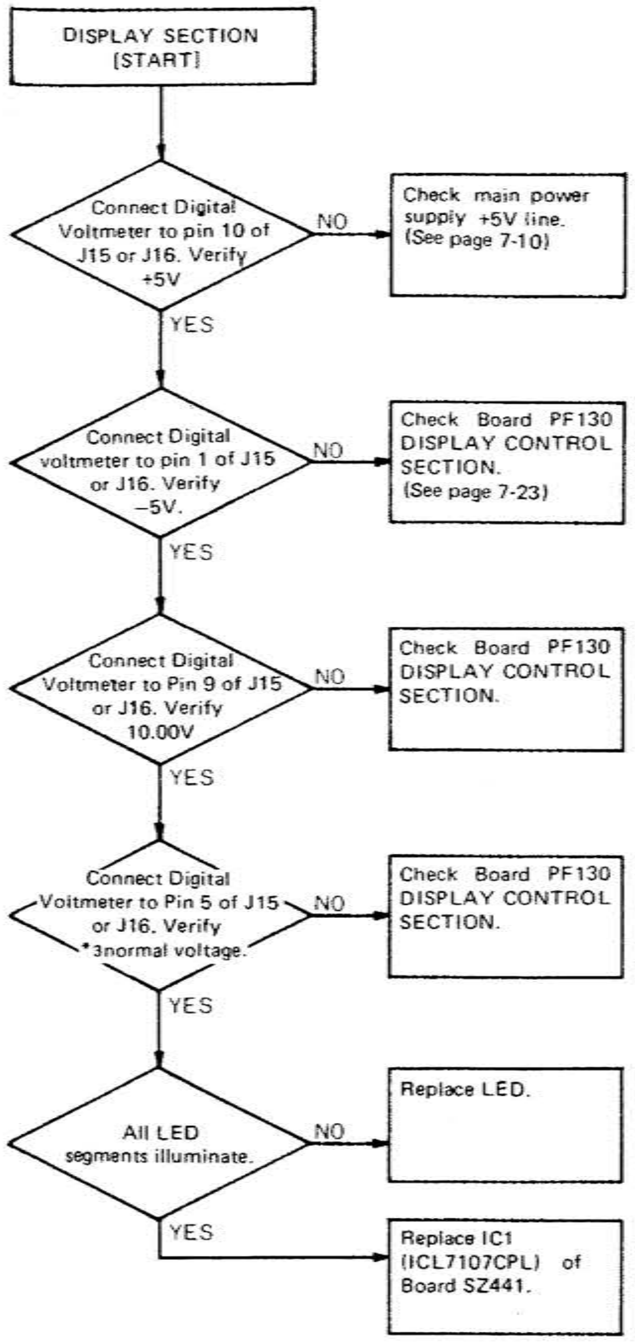
Displaying 100 . . . . 1.00V

Displaying 110 . . . . 1.10V

Where fluctuation of about o.01V is unavoidable due to tolerance of resistor on Board SZ441.

[*1] ccw: counter clockwise

[*2] cw: clockwise


DISPLAY SECTION [START]
Connect Digital Voltmeter to pin 10 of J15 or J16. Verify +5V
NO
Check main power supply +5V line. (See page 7-10)
YES
Connect Digital voltmeter to pin 1 of J15 or J16. Verify –5V.
NO
Check Board PF130 DISPLAY CONTROL SECTION. (See page 7-23)
YES
Connect Digital Voltmeter to Pin 9 of J15 or J16. Verify 10.00V
NO
Check Board PF130 DISPLAY CONTROL SECTION.
YES
Connect Digital Voltmeter to Pin 5 of J15 or J16. Verify *3normal voltage.
NO
Check Board PF130 DISPLAY CONTROL SECTION.
YES
All LED segments illuminate.
NO
Replace LED.
YES
Replace IC1 (ICL7107CPL) of Board SZ441.

[*3] Outputs the voltage corresponding to REFERENCE LEVEL display at 1 : 1 same as TP5.

Figure 5.32
TROUBLESHOOTING CHART 7

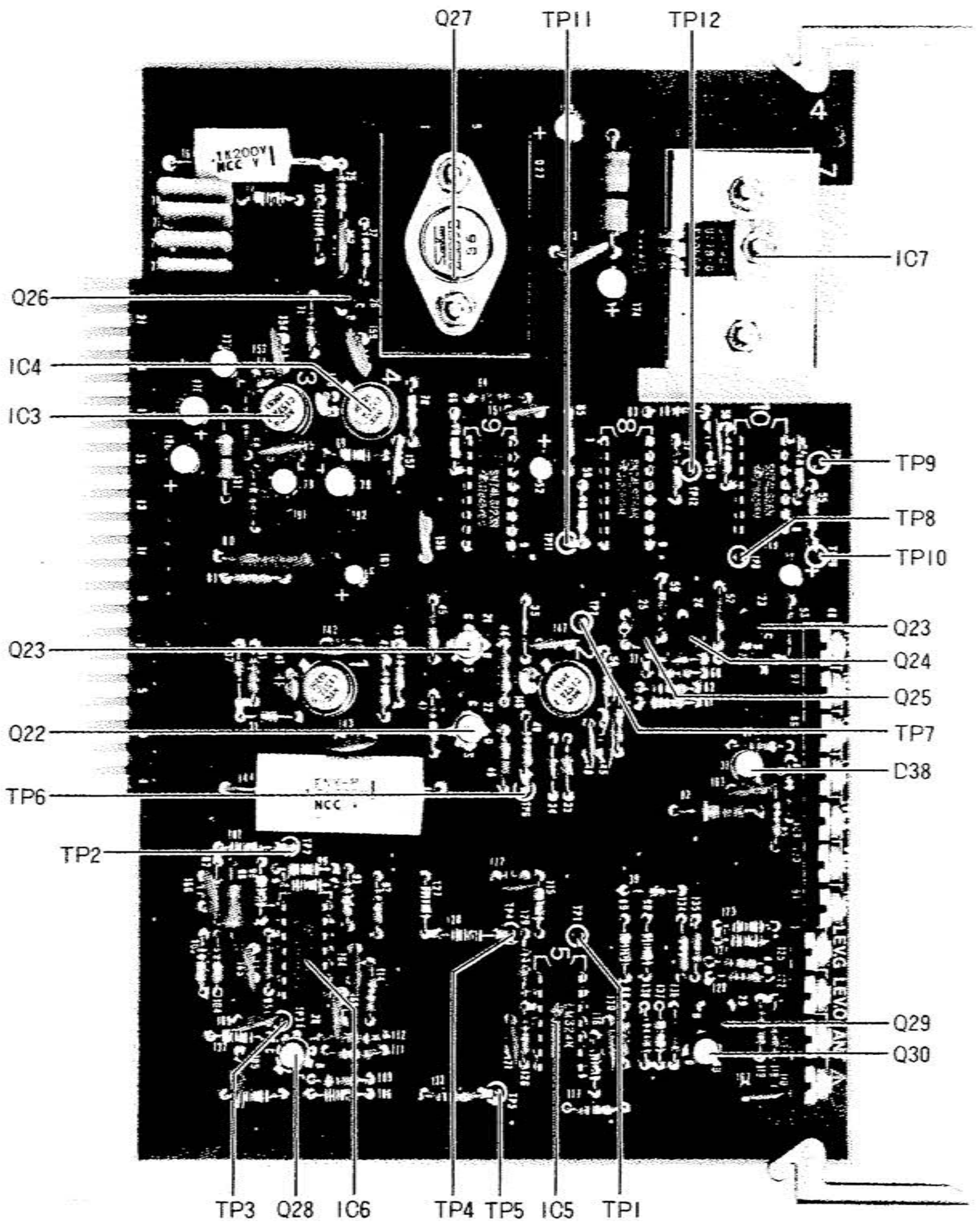

Q27
TP11
TP12
IC7
Q26
IC4
IC3
TP9
TP8
TP10
Q23
Q24
Q25
TP7
D38
Q23
Q22
TP6
TP2
Q29
Q30
TP3
Q28
IC6
TP4
TP5
IC5
TP1

Figure 5.31 RAMP GENERATOR & YIG DRIVER (PF130) CHECK POINTS

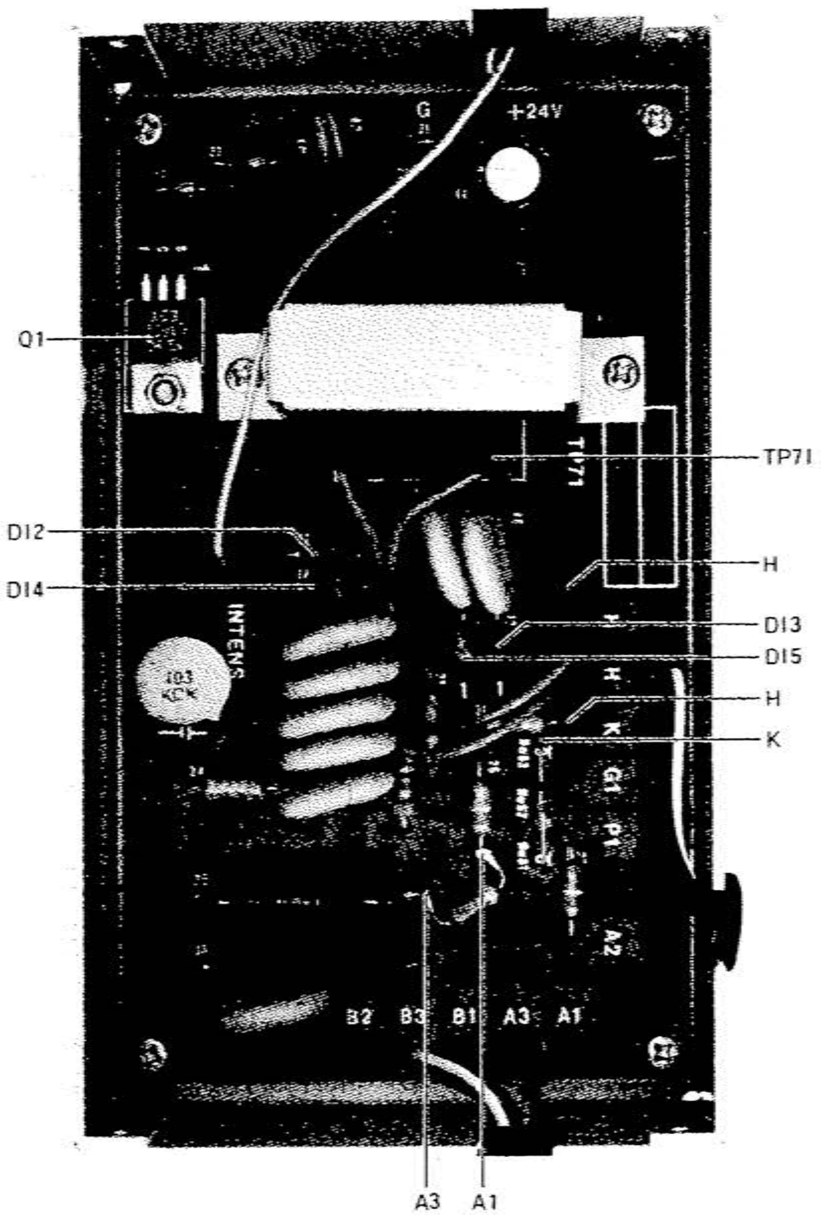
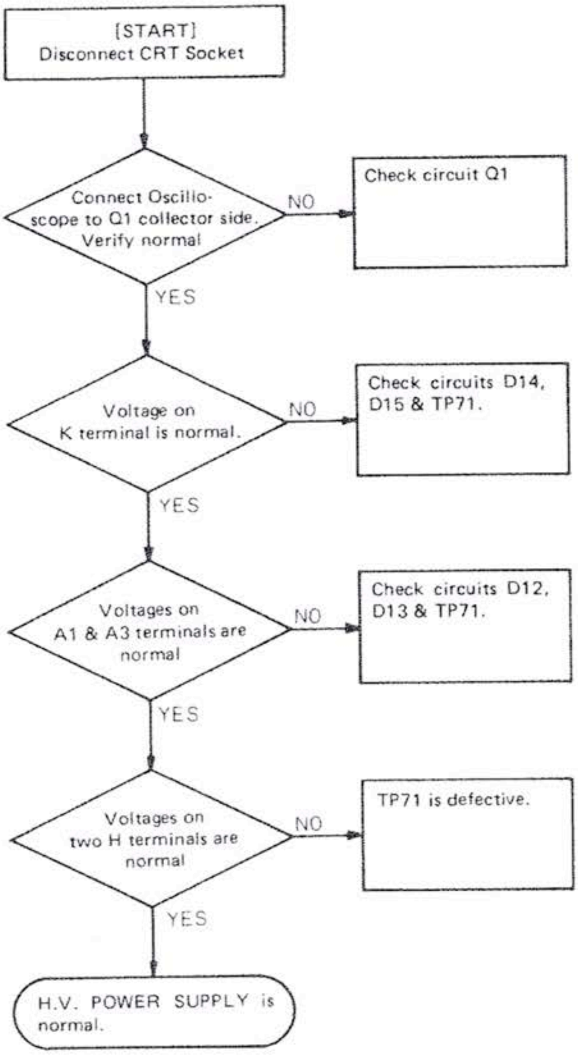
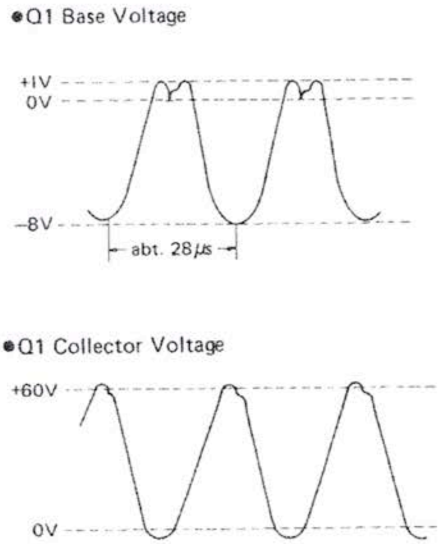

Q1
D12
D14
TP71
H
D13
D15
H
K
A3
A1
G
+24V
INTENS
T171
G1
P1
A2
B2
B3
B1
A3
A1

Figure 5.33 H.V. POWER SUPPLY (MEP265) CHECK POINTS

BOARD MEP265 H.V. POWER SUPPLY


[START]
Disconnect CRT Socket
Connect Oscillo-scope to Q1 collector side. Verify normal
NO
Check circuit Q1
YES
Voltage on K terminal is normal.
NO
Check circuits D14, D15 & TP71.
YES
Voltages on A1 & A3 terminals are normal
NO
Check circuits D12, D13 & TP71.
YES
Voltages on two H terminals are normal
NO
TP71 is defective.
YES
H.V. POWER SUPPLY is normal.


●Q1 Base Voltage

+IV
0V
−8V
abt. 28μs

●Q1 Collector Voltage

+60V
0V

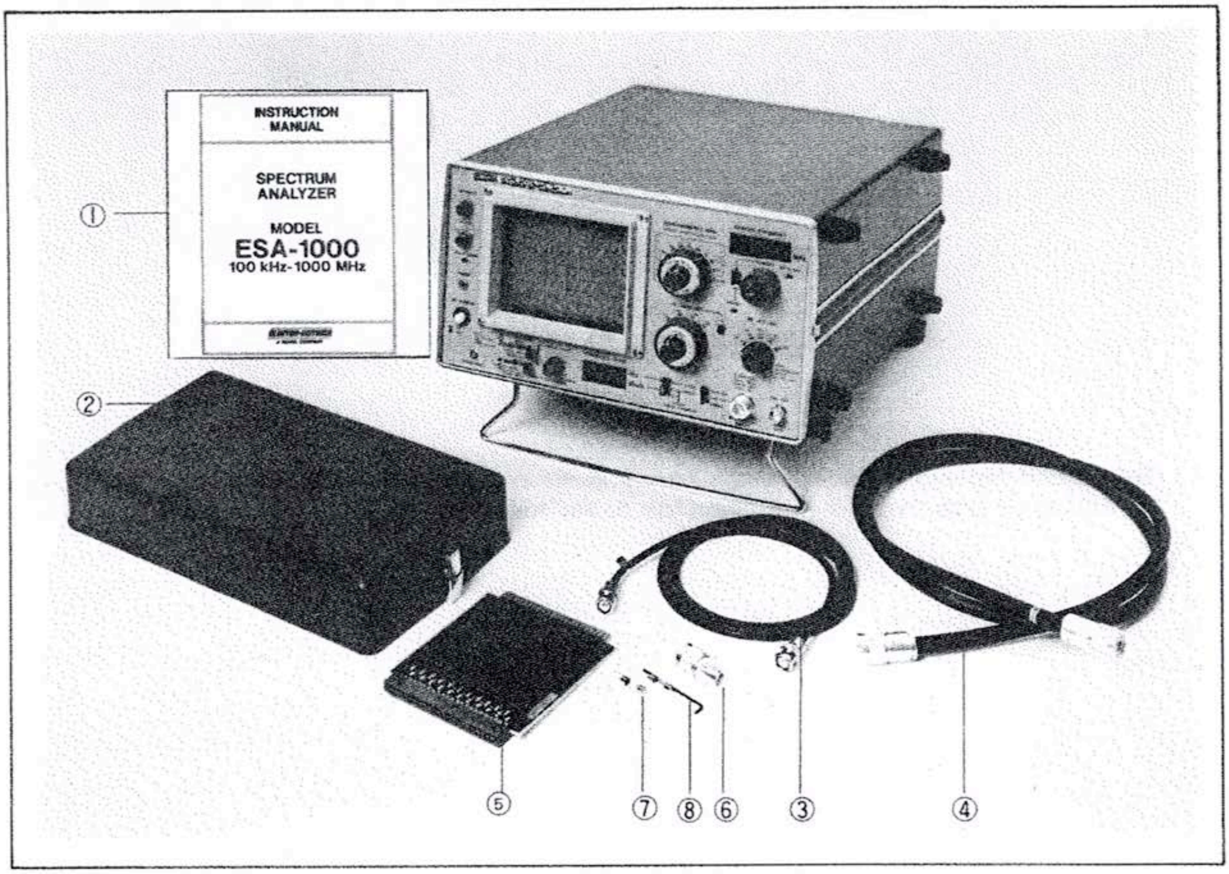
●K terminal voltage	abt. −2kV
●A1 terminal voltage	abt. −2.1kV
●A3 terminal voltage	abt. −2kV
●H terminal voltage	abt. −2kV

Figure 5.34
TROUBLESHOOTING CHART 8

SECTION VI

Accessory Data

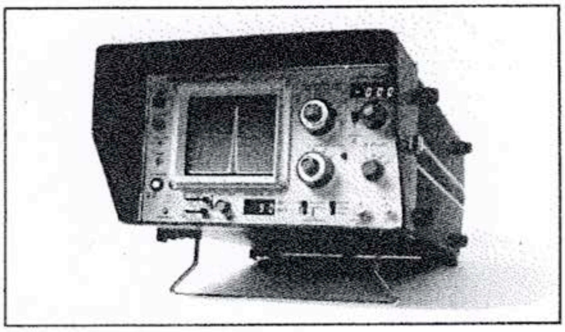
This section contains information/data on the accessory items which are applicable for utilization with the ESA-1000 Spectrum Analyzer.


INSTRUCTION MANUAL
SPECTRUM ANALYZER
MODEL
ESA-1000
100 kHz-1000 MHz
①
②
⑤
⑦
⑧
⑥
③
④

ESA-1000 STANDARD ACCESSORY SET

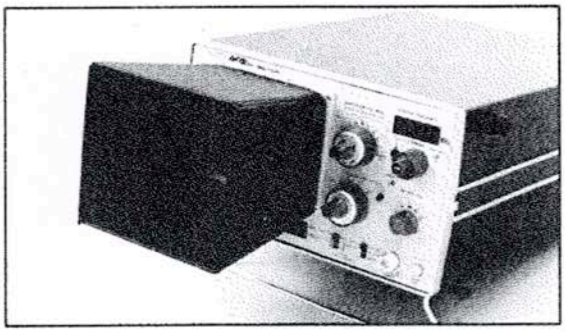
1. Instruction Manual
2. Front Panel Cover
3. BNC-BNC Cable (UG-88/μ) MI-02
4. Type N-Type N Cable (UG-21P/μ) MI-04
5. 22 Pin Extender Board
6. N-BNC Adapter (JUG-201A/μ)
7. 0.5A/115 VAC Slow Blow Fuse
8. 3 mm Hexagonal Wrench

NOTE: The power cable is connected to the instrument.



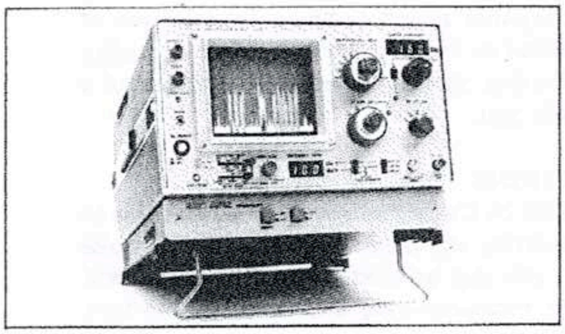
FPH-1000 Front Panel Hood

Stock No.: FPH-1000-



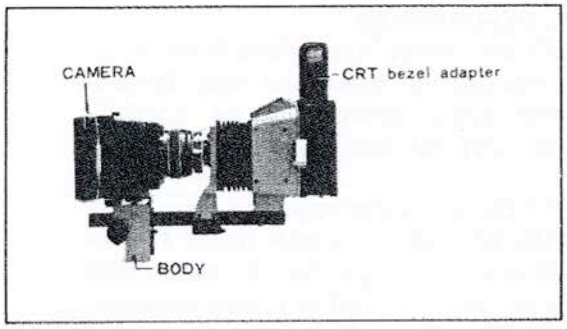
H-1000, CRT Hood

It is designed to cover the CRT section of the ESA-1000. Spectrum Analyzer for use outdoors or at bright environment. Stock No.: H-1000-



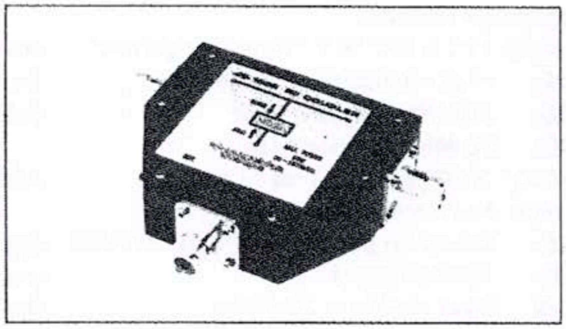
DM-1000 Digital Memory

Display resolution: X axis 9-bit 512-point
Y axis 8-bit 256-point
Horizontal input sweep rates: 20 ms to 10s
Display refresh rate: Approx. 4 ms, repetition of fullscale
Sampling error: Y axis, within ±25%
Store function: Content of memory is stored by setting **SCAN MODE** to **"MANUAL".**
Display function: A Content of memory A displayed.
A/B Content of memory A and B displayed
Operating temperature range: 0°C to +40°C
Power requirement: Supplied from ESA-1000
Power consumption: Approx. 25 VA
Dimensions: about 11.4"(W) x 1.6"(H) x 15.3"(D)
(290 x 40 x 390 mm)
Weight: about 7.0 lbs. (3.2 kg)
Stock No.: DM-1000- (Factory Option)



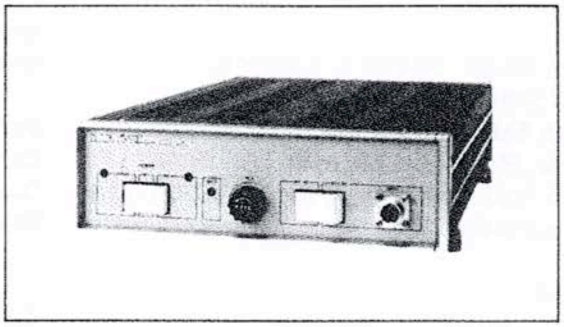
Camera Mount Complete Set
CAM-1000

This set is composed of camera mount, camera and attachment, and is stored in a steel bag.



C-1000 RF Coupler

Frequency range: DC to 1000 MHz
Maximum input: 50 W
Coupling degree: 40 dB ± 1 dB
Impedance: 50/main & sub routes
V.S.W.R.: 1.5 or less
Insertion loss: 1 dB or less
Connector: Main route/N type, sub routes/ BNC type
Stock No.: C-1000-

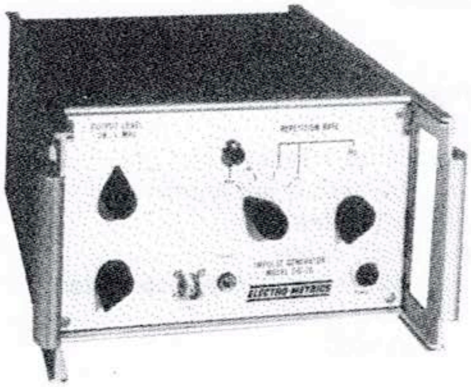


BAT-1000 Battery Pack

Internal battery capacity: 10 AH (12V) Ni-Cd
Continuous operating hour
: about 3.0 hours
Charging hour : about 15 hours
External battery: +10V to +15V
Discharging hour: AC100V ± 10%, 50/60 Hz, about 35VA
Environmental temperature
: 0°C to +35°C (in operation)
Dimensions: abt. 11.6"(W) x 3.5"(H) x 19.7"(D)
(294 x 87 x 500 mm)
Weight: about 26 lbs. (12 kg)
Stock No.: BAT-1000-

Other Accessories Include:

1. EXY-125B:11:: x 17:: X-Y Plotter (single pen)
2. EHF-25: High intelligibility earphones
3. HPF-30: 30 MHz high pass filter
4. LPF-30: 30 MHz low pass filter
5. LPF-1000: 1000 MHz low pass filter
6. ICC-1000: Instrument carrying case
7. PCL-25: Clamp-on probe, 10 kHz to 110 MHz
8. TRI-25: Tripod-rugged
9. MSA-25: Mast section – 20 inches



CIG-25 IMPULSE GENERATOR

SPECIFICATIONS

Electrical

Frequency Range: 10 kHz to 1000 MHz
Average VSWR: 1.7:1
Repetition Rate: 1 to 100 Hz
Impedance: Matched to 50 ohms
Calibrated Frequency Range: 10 kHz to 1000 MHz
Output connector: TNC

Mechanical

Length: 11-7/8"
Width: 8-3/16"
Height: 5-13/16"
Weight: 6 lbs.

GENERAL DESCRIPTION

Calibrated Impulse Generator, Model CIG-25, is a reliable source of calibrated impulses at variable repetition rates.

The CIG-25 provides a repetition rate variable between 1 and 100 Hz, (1 Hz steps between 1 and 10 Hz, 10 Hz steps between 10 Hz and 100 Hz) and a provision for synchronizing with, and operating at the AC line frequency. A front-panel push-button switch also provides for generating a single impulse.

A front-panel switch provides for selection of either positive or negative polarity of the impulse, thus facilitating checks for possible overload of a defice under test.

APPLICATIONS

The CIG-25 Calibrated Impulse Generator is an ideal calibrating standard for use with RF noise meters. It can also be used for receiver alignment, bandwidth measurements, and for checking transient response.

The CIG-25 is designed specifically for operation in conjunction with Electro-Metrics Interference Analyzer Model, EMC-25 or CPR-25 and the ESA-1000 Spectrum Analyzer.

Certification is tracible to the National Bureau of Standard.

EFP-25 ELECTRO-STATIC FIELD PROBE

SPECIFICATIONS

Electrical

Frequency Range: 10 kHz – 1000 MHz
Impedance: 50 ohms nominal
Output Connector: TNC

Mechanical

Length: 11"
Diameter: 1¼"
Weight: 1 lb.

GENERAL DESCRIPTION

The EFP-25 Electro-Static Field Probe is designed to operate in conjunction with Electro-Metrics Interference Analyzer, Model EMC-25, CPR-25, or other 50 ohm input impedance receivers.

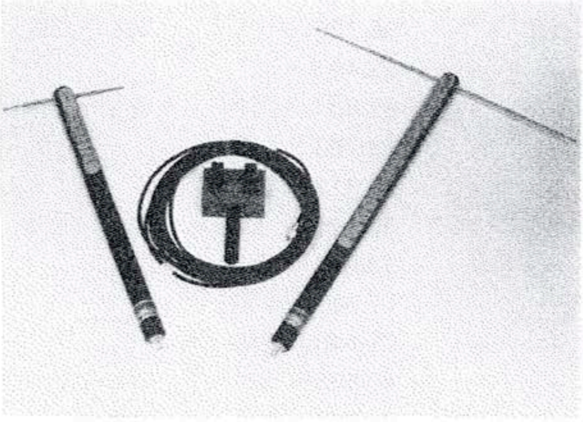
The EFP-25 covers the frequency range of 10 kHz to 1000 MHz which matches bands 1-15 on the EMC-25 and CPR-25 and the 100 kHz to 1000 MHz range of the ESA-1000 Spectrum Analyzer.

The EFP-25 probe is non-calibrated and hand held for versatility and mobility.

APPLICATIONS

The EFP-25 Electro-Static Field Probe is particularly suited for searching for radio frequency (RF) leakage.

The probe is especially useful in determining the side of an article under test which radiates the highest level prior to running a MIL-STD or FCC radiated emissions test.



TDS-25 TUNABLE DIPOLE SET

SPECIFICATIONS

Electrical

Frequency Range: 200 to 1000 MHz
TDS-25-1: 200 to 500 MHz
TDS-25-2: 500 to 1000 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
200 to 100 MHz Antenna Factor
Charts furnished with each antenna
Output Connector: TNC

Mechanical:

Height: TDS-1 23"
TDS-2 18"
Weight: 2 lbs.
Length: adjustable

GENERAL DESCRIPTION

The tuned dipole is the reference antenna for both FCC and VDE measurements in the 200 to 1000 MHz range. Results from other linearly-polarized antennas in the verification/certification process must be correlated with the results obtained from a tuned dipole.

The adjustable dipole is used for radiated emissions compliance testing when used with a 50 ohm input impedance field intensity meter.

When used with Electro-Metrics interference analyzers, the coverage range of 200 to 1000 MHz matches that of bands 14 (200-500 MHz) and band 15 (500-1000 MHz).

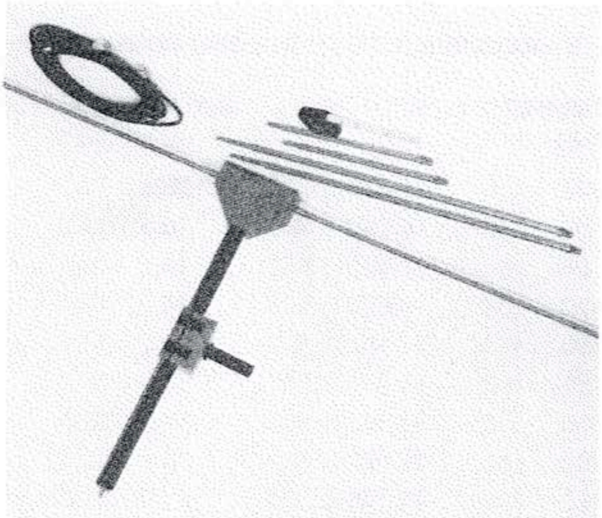
Included within the structure of each dipole mount is a balum transformer which transposes the balanced dipole to the unbalanced coaxial line.

APPLICATIONS

The TDS-25 is designed for measuring field strength intensities in conjunction with Military, FCC, VDE and ANSI specification. The TDS-25 is equipped with coaxial cable CAC-25 and clamp mount CMT-25 which attaches to optional Tripod TRP-25 or Mast Section MSA-25 by means of Antenna Mount (AMT-25) (optional).

TDS-25
ANTENNA FACTOR CHART

TDS-25-1		TDS-25-2	
Antenna Factor (dB)	Dipole Length (MHz)	Antenna Factor (db)	Dipole Length (MHz)
200-500 MHz		500-1000 MHz	
25	500	32	1000
24	450	31	900
23	400	30	800
22	350	28	700
21	325	27	600
20	300	26	550
19	280	25	500
18	260		
18	240		
17	220		
16	200		



TDA-25 TUNABLE DIPOLE ANTENNA

SPECIFICATIONS

Frequency Range: 30-200 MHz
Impedance: 50 ohms
Calibrated Frequency Range:

30-200 MHz
Frequency conversion tape
is calibrated with necessary
antenna correction factors
Output Connector: TNC
Length: 15.6 ft at 30 MHz
Width: 2"
Diameter: 2.3 ft at 200 MHz
Height: Boom 23-9/16" over all

GENERAL DESCRIPTION

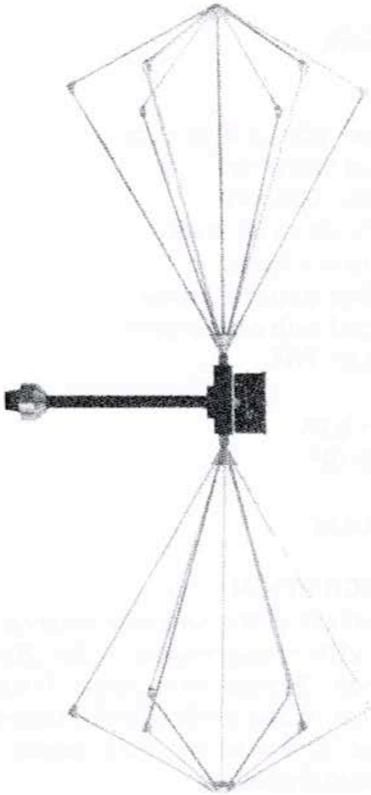
The TDA-25 is designed to operate over the 30-200 MHz frequency range. The two sets of elements are made from stainless steel plus a fixed-length extension rod also made of stainless steel. The elements mount in a balun network fabricated of phemolic and the necessary impedance matching components. The adjustable dipole elements are set by using the frequency conversion scale (FCS-25).

APPLICATIONS

The TDA-25 complements the TDS-25 to provide tuned dipole coverage for the full range of radiated measurements to comply with the latest FCC and SAE specifications. The TDS-25 is equipped with coaxial cable to CAC-25 and clamp mount CMT-25 which attaches to optional Tripod TRP-25 or Mast Section MSA-25 by means of Antenna Mount AMT-25 (also optional).

TDA-25 FREQUENCY TO INCH CONVERSION

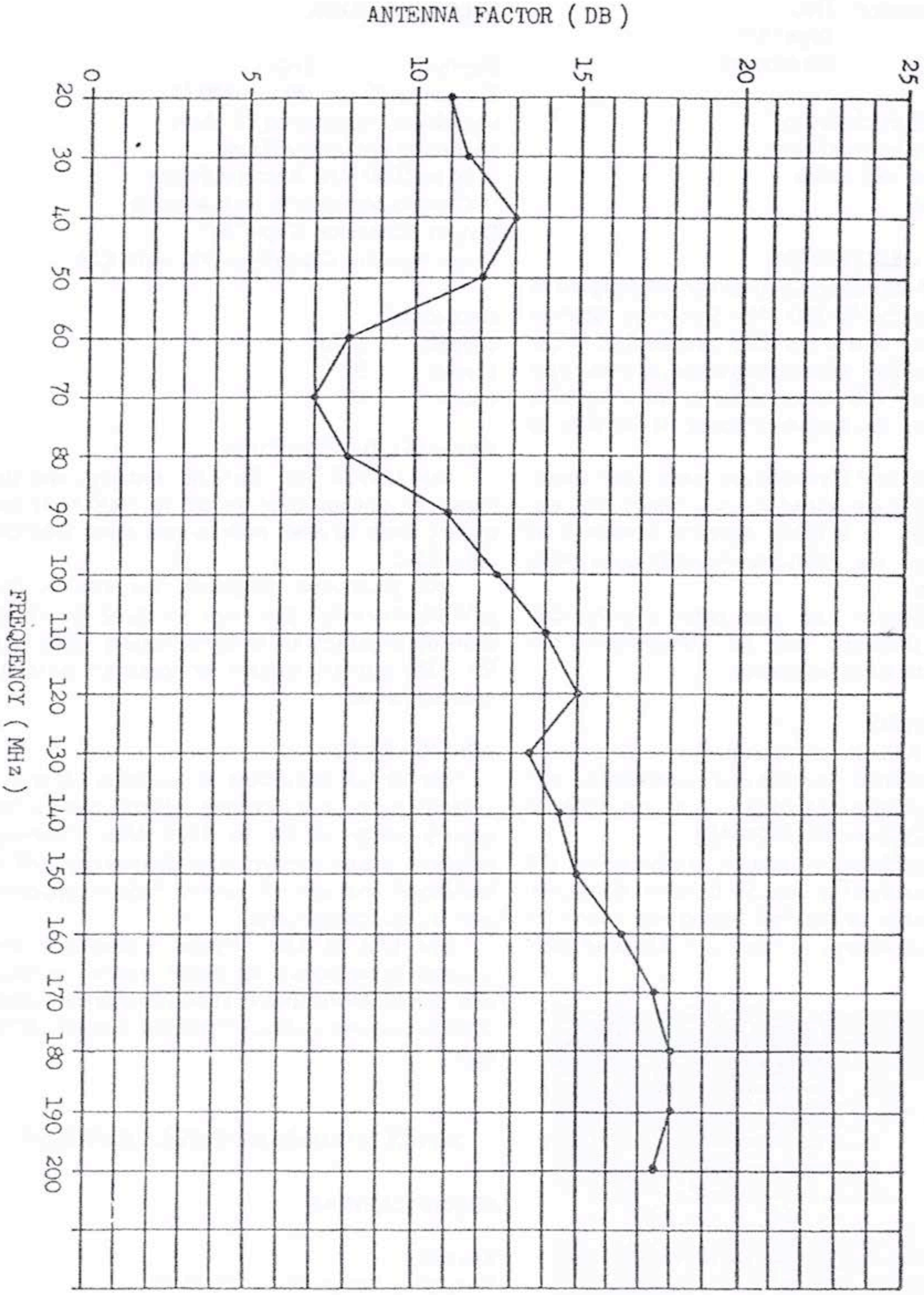
FREQUENCY (MHz)	INCH	ANT FACTOR (dB)
200	14.000	16.0
190	14.750	15.0
180	15.652	14.5
170	16.500	14.0
160	17.562	13.5
150	18.687	13.0
140	20.062	12.5
130	21.562	12.0
120	23.375	11.0
110	25.500	10.0
100	28.062	9.5
–	29.500	
90	31.187	8.5
–	33.000	
80	35.062	7.5
–	37.375	
70	40.062	6.5
–	43.187	
60	46.750	5.0
–	51.000	
50	56.125	3.5
–	58.437	
–	61.000	2.5
–	63.750	
–	66.812	
40	70.125	1.5
–	73.812	
–	77.937	
–	82.500	
–	87.625	
30	93.500	-1.0



BIA-25 BICONICAL ANTENNA

SPECIFICATIONS

Electrical
Frequency Range: 20 to 200 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:



TYPICAL ANTENNA FACTOR CHART
FOR
THE BIA-25 BICONICAL ANTENNA

20 to 200 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: TNC
Type "N"
(on request)

Mechanical
Length: 56.5 in. tip-to-tip
Diameter: 21 in. maximum
Depth: 32 in. incl. balun
Weight: 6 lb.

GENERAL DESCRIPTION

The BIA-25 Biconical Antenna was designed to operate over the 20-200 MHz frequency range to meet military and other EMI specifications. The BIA-25 is capable of operating either as a transmitting antenna (100 watts max.) or as a receiving antenna over the frequency range of 20 MHz to 200 MHz.

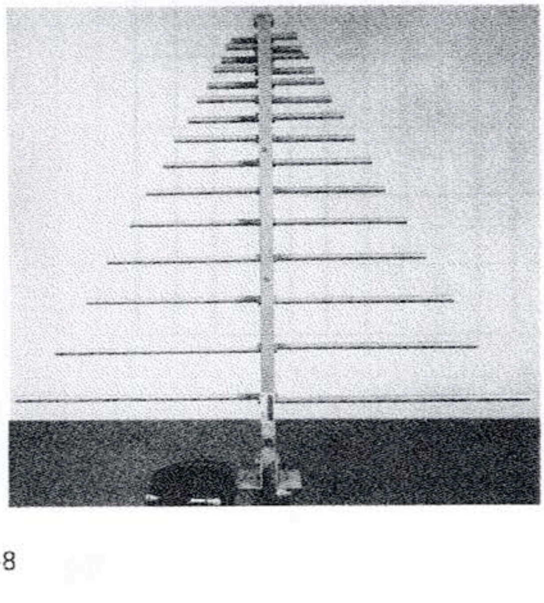
The Biconical elements are made from aluminum rods and are joined by tack welds. The elements mount in a balun network fabricated of phenolic and the necessary impedance-matching components.

Upon request, we also offer a collapsible biconical. Elements can be conveniently disassembled for travel or storage.

APPLICATIONS

The BIA-25 Biconical Antenna is particularly suited to radiated emission and susceptibility specification compliance testing such as is outlined in MIL-STD-826A and MIL-STD-462.

The broadband frequency capability of the BIA-25 eliminates the need for band switching, element extension or external tuning when used for EM ambient surveys or spectrum signature measurements.



LPA-25 LOG PERIODIC ANTENNA

SPECIFICATIONS

Electrical
Frequency Range: ~~20~~ 200 to 1000 MHz
Impedance: Nominal to 50 ohms
Calibrated Frequency Range:
20 to 1000 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: Type "N"
Power Handling Capability: 200 watts C.W.

Mechanical
Weight: 10 lbs.
Length: 36"
Width: 40"

GENERAL DESCRIPTION

The LPA-25 Log Periodic Antenna was designed to operate over the 20 to 1000 MHz frequency range to meet military and other EMI specifications.

The broadband frequency capacity of the LPA-25 eliminates the need for band switching, element extension or external tuning when used for EMI ambient surveys or spectrum signature measurements.

APPLICATIONS

The LPA-25 is capable of operating either as a transmitting or as a receiving antenna over the frequency range of 20 to 1000 MHz. Linearly-polarized design permits separate measurement of horizontal and vertical electric field components over its established range.

The LPA-25 Log Periodic Antenna is particularly advantageous for use in radiated emission and susceptibility specification compliance testing such as outlined in MIL-STD-826A and MIL-STD-462.

BDA-25 BROADBAND DIPOLE ANTENNA

SPECIFICATIONS

Electrical
Frequency Range: 20 to 200 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
20 to 200 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: TNC

Mechanical

Length:

Main: 19"	100-200 MHz	
Extensions: 21" –	45-100 MHz	
36" –		20–45 MHz

GENERAL DESCRIPTION

The tuned dipole is the reference antenna for both the FCC and VDE measurements in the 30 to 1000 MHz range. Results from other linearly-polarized antennas in the verification/certification process must be correlated with the results obtained from a tuned dipole.

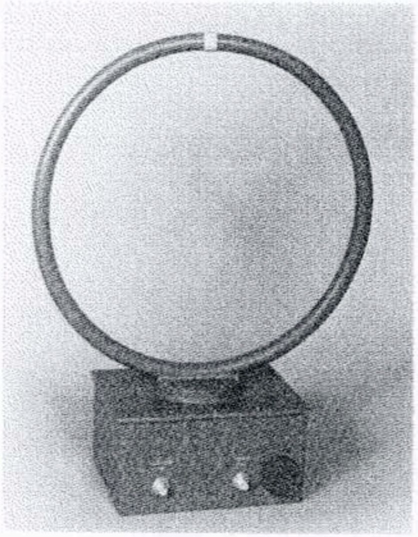
The BDA-25 Broadband Dipole Antenna is designed specifically for operation in conjunction with Electro-Metrics Interference Analyzer Model EMC-25 or CPR-25. Its coverage of 20 to 200 MHz matches that of Bands 11-13 of the EMC-25 and CPR-25, plus the ESA-1000.

Included within the structure of the dipole mounting is a balun transformer which transposes the balanced dipole to the unbalanced coaxial line is slightly mismatched to provide optimum broadbanding of its reception characteristic.

APPLICATION

The BDA-25 is designed for measuring field strength intensities and is fixed tuned in three broadbands by means of easy-to-add dipole arm extensions.

The antenna is statically balanced and equipped with an adapter and mount (AMT-25) which attaches to Tripod TRP-25 or Mast Section MSA-25. Its one-inch diameter rods provide greater surface area, resulting in improved broadband sensitivity.



ALR-25(M) MANUAL LOOP ANTENNA

SPECIFICATIONS

Electrical

Frequency Range: 10 kHz to 30 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
10 kHz to 30 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: TNC

Mechanical

Outside Diameter: 17"
Height: 20"
Weight: 8 lbs.

GENERAL DESCRIPTION

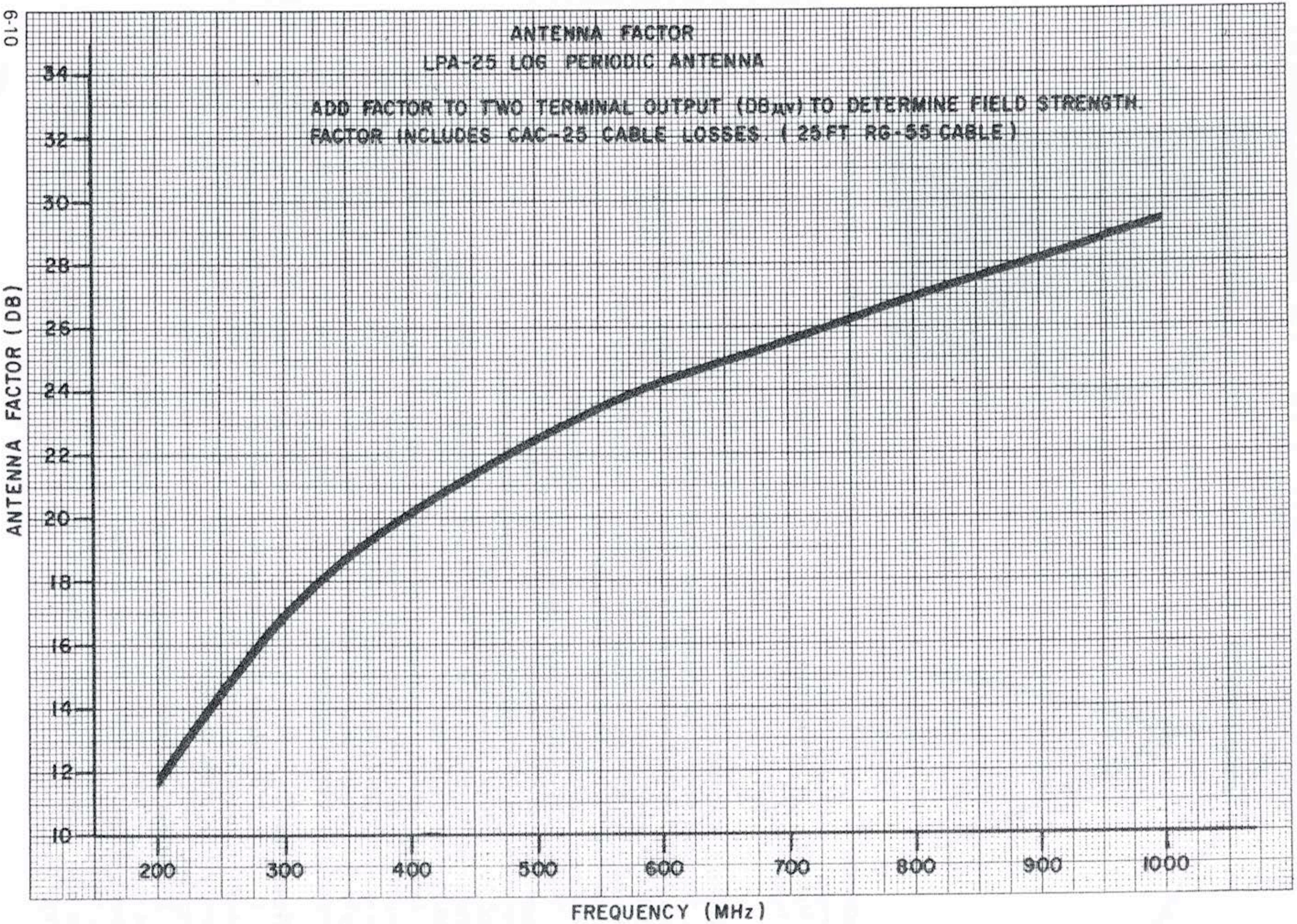
The Loop Antenna Model ALR-25(M), is designed specifically for use with Electro-Metrics Interference Analyzer, EMC-25 or CPR-25 and the ESA-1000. The ALR-25 covers the same frequency range (10 kHz to 30 MHz) as the first ten RF bands of the EMC-25 and CPR-25 plus the ESA-1000 frequency range of 100 kHz to 30 MHz. The matching network is switched for optimum operation at the particular frequency selected.

Model ALR-25(M) is supplied with 25 ft. of RF Cable and frequency ranges are manually selected on the side of the antenna.

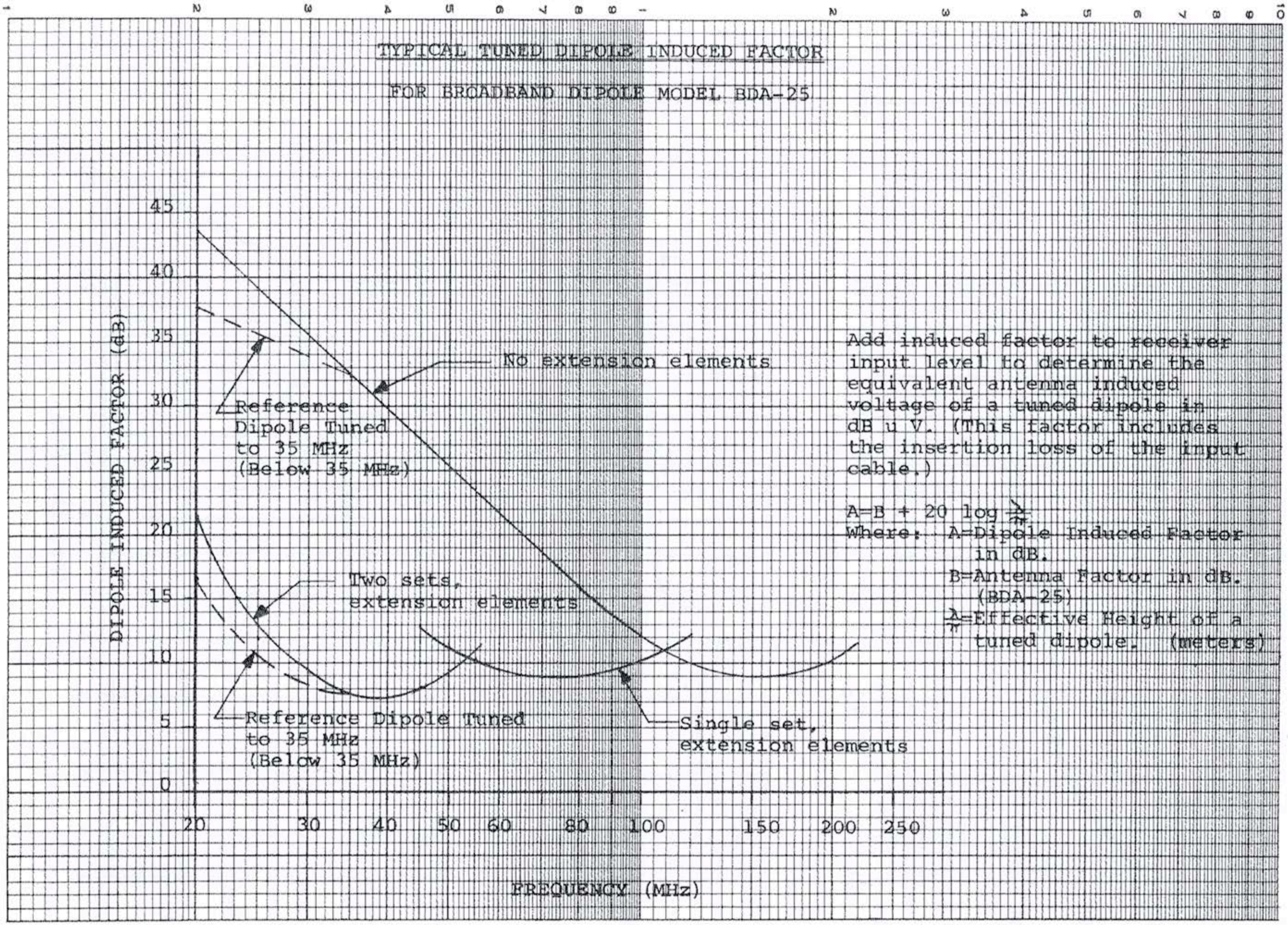
APPLICATION

Model ALR-25(M) uses passive circuits to transform magnetic field components between 10 kHz to 30 MHz to voltage in an EMC-25 – CRP-25 – ESA-1000 50 ohm input system.

TYPICAL ANTENNA FACTOR
LPA-25 LOG PERIODIC ANTENNA



TYPICAL ANTENNA FACTOR, BROADBAND DIPOLE MODEL BDA-25



TYPICAL TUNED DIPOLE INDUCED FACTOR

FOR BROADBAND DIPOLE MODEL BDA-25

Add induced factor to receiver input level to determine the equivalent antenna induced voltage of a tuned dipole in dB u V. (This factor includes the insertion loss of the input cable.)

$A=B + 20 \log \frac{\lambda}{\pi}$

Where: A=Dipole Induced Factor in dB.

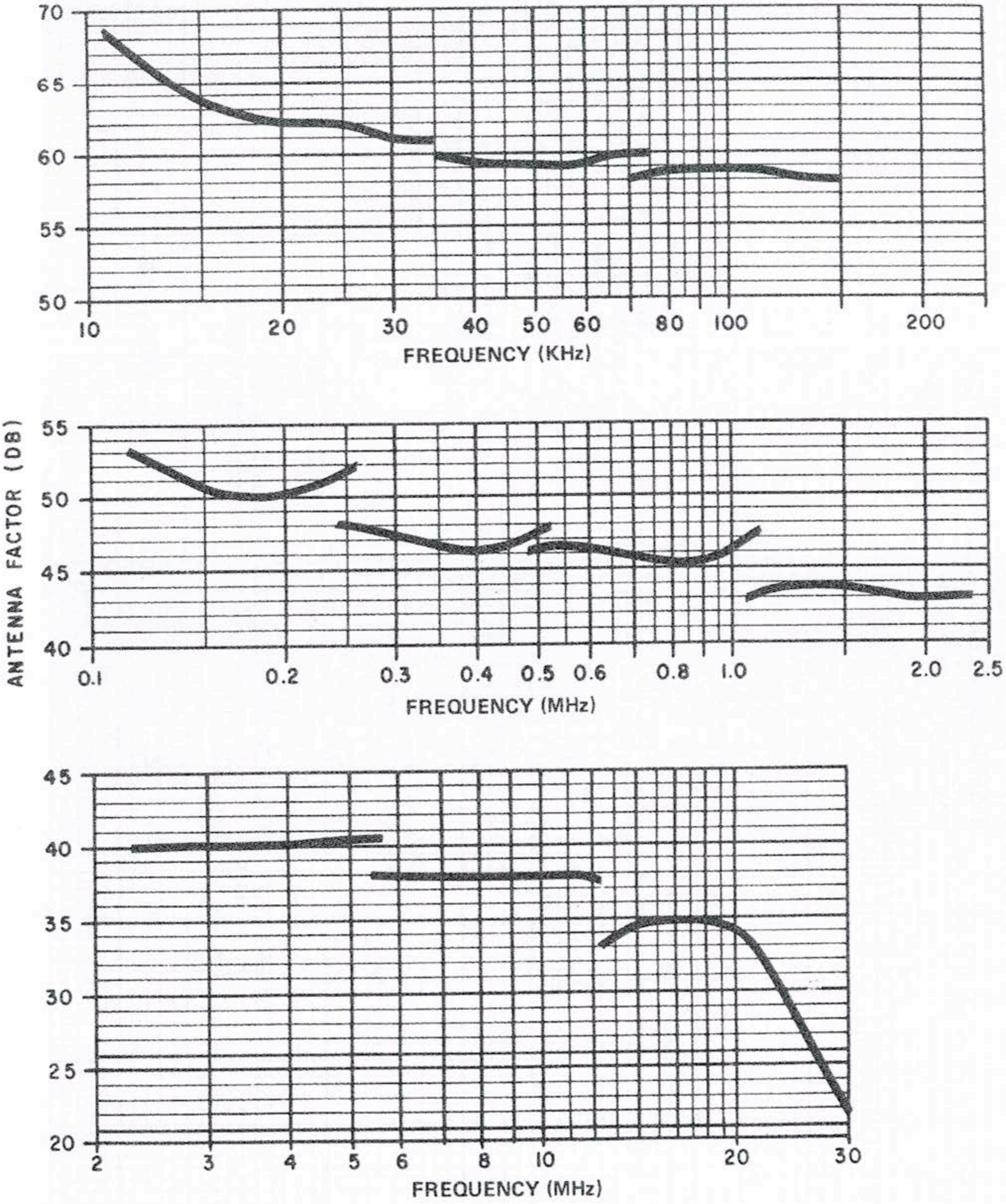
B=Antenna Factor in dB. (BDA-25)

$\frac{\lambda}{\pi}$=Effective Height of a tuned dipole. (meters)

DIPOLE INDUCED FACTOR (dB)
45
40
35
30
25
20
15
10
5
0
FREQUENCY (MHz)
20
30
40
50
60
80
100
150
200
250
No extension elements
Reference Dipole Tuned to 35 MHz (Below 35 MHz)
Two sets, extension elements
Reference Dipole Tuned to 35 MHz (Below 35 MHz)
Single set, extension elements

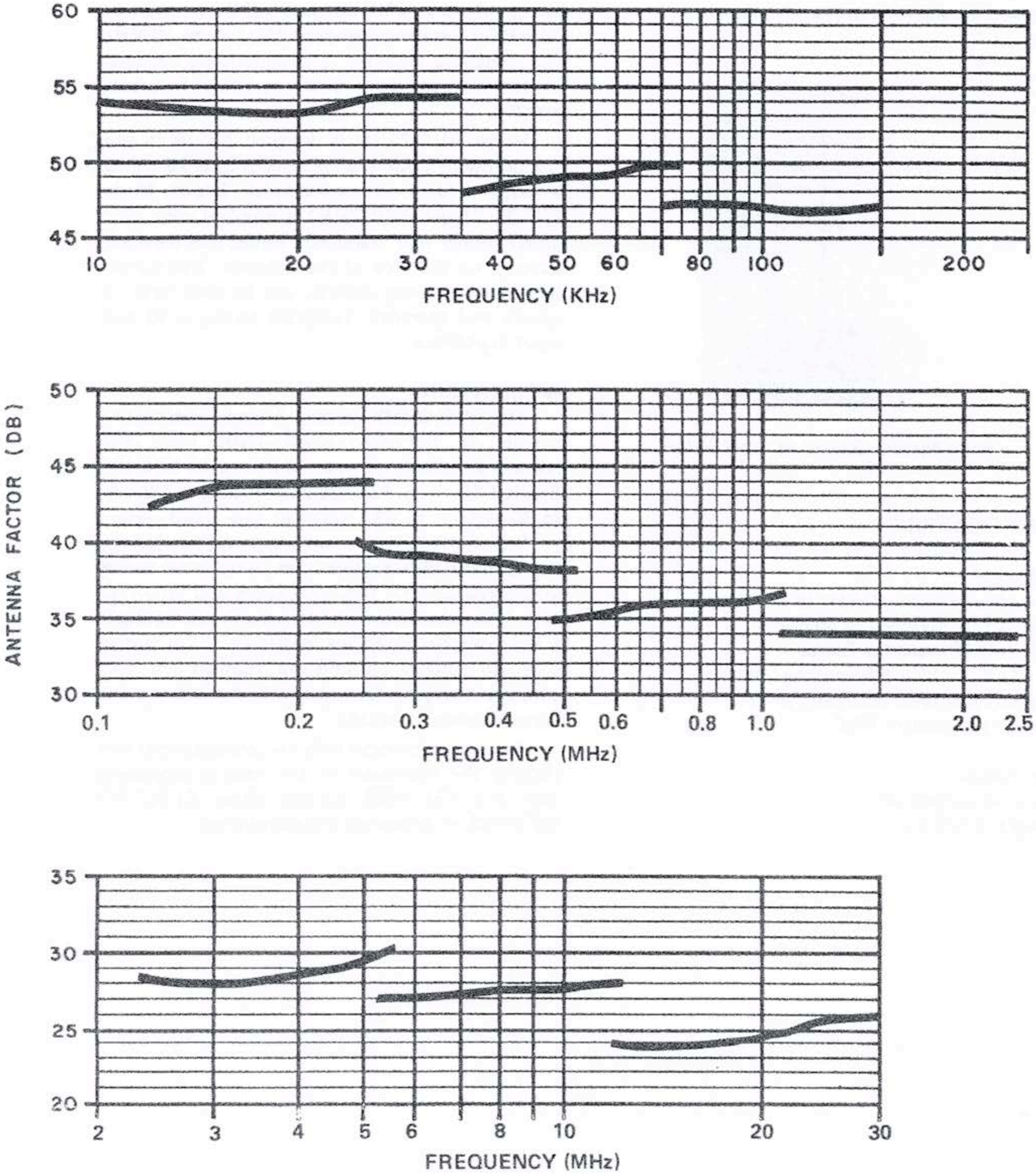
TYPICAL ANTENNA FACTOR CHART

ALR-25

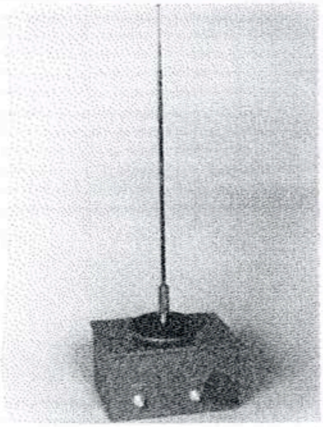


TYPICAL ANTENNA FACTOR CHART

RVR-25



The ALR-25(M) is particularly suited for application in military EMI specification compliance testing such as is outlined in the MIL-STD-826A and MIL-STD-462. This antenna can also be used in power line and the testing of ultra-sonic devices as per FCC dockets. Calibration data and antenna patterns are supplied with each antenna.



RVR-25(M) VERTICAL ANTENNA

SPECIFICATIONS

Electrical

Frequency Range: 10 kHz to 30 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
10 kHz to 30 MHz Antenna Factor Chart furnished with each antenna
Output Connector: TNC

Mechanical

Antenna Length: 41"
Weight: 7-1/2 lbs.

GENERAL DESCRIPTION

The RVR-25(M) Remote Vertical Antenna is designed specifically for use with Electro-Metrics Interference Analyzer, Model EMC-25 or CPR-25. Model RVR-25(M) covers the same frequency range (10 kHz to 30 MHz) as the first ten RF bands of the EMC-25 and CPR-25 and the ESA-1000 frequency range of 100 kHz to 30 MHz. The matching network is automatically switched for optimum operation at the particular frequency selected.

Model RVR-25(M) is designed for use in conjunction with Counterpoise, Model GPA-25 (which is required for most applications); Tripod, Model TRP-25. Model RVR-25(M) is supplied with 25 ft. of RF Cable and frequency ranges are manually selected on the side of the antenna. The manual version of the rod antenna can be used with receivers and spectrum analyzers having a 50 ohm input impedance.

APPLICATION

The RVR-25(M) Vertical Antenna uses passive circuits to transform electro-static field components to voltage between 10 kHz to 30 MHz (RF Bands 1-10) in an EMC-25 or CPR-25 and 100 kHz to 30 MHz in an ESA-1000 50 ohm input system.

The RVR-25(M) is manufactured particularly for military EMI specification compliance testing in accordance with MIL-STD-826A and MIL-STD-462. This antenna can also be used in the testing of a high voltage power line interference. Calibration data and antenna patterns are supplied with each antenna. Carrying Case available for storage and transportation (LAC-25).

For any additional information/questions concerning the operation of the various accessories with the ESA-1000, contact either ELECTRO-METRICS or its nearest representatives.

SECTION VII

Reference Data

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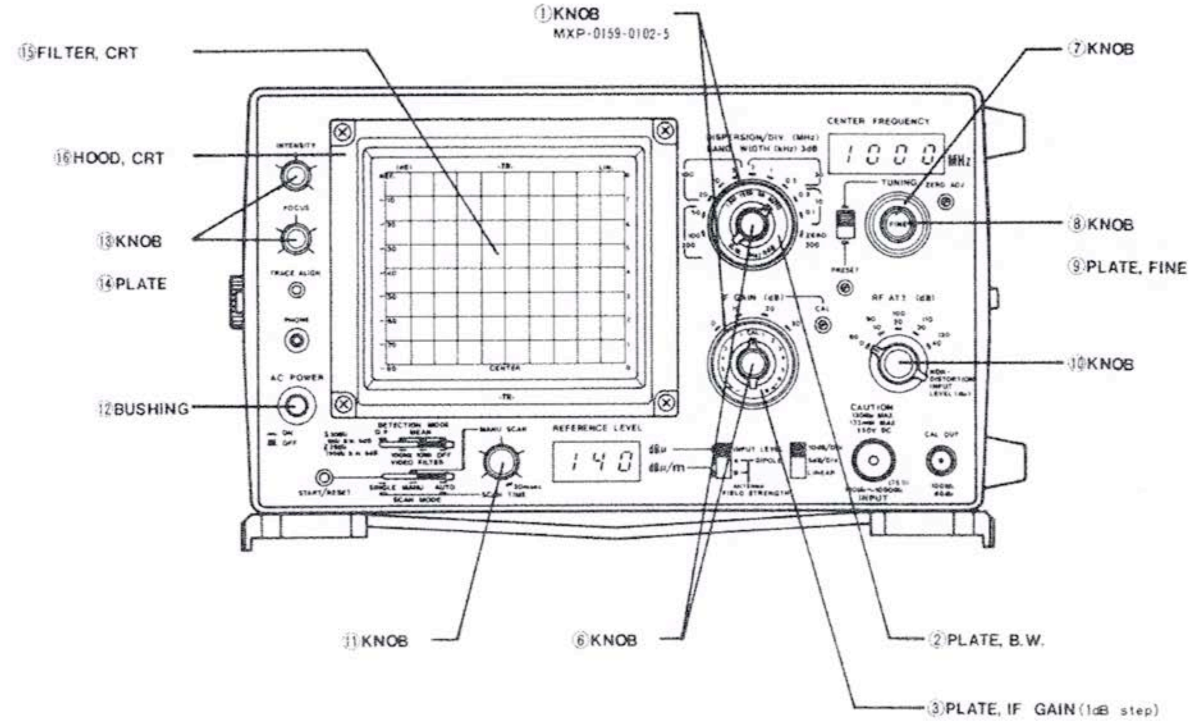

①KNOB
MXP-0159-0102-5
⑮FILTER, CRT
⑦KNOB
⑯HOOD, CRT
⑬KNOB
⑭PLATE
⑧KNOB
⑨PLATE, FINE
⑩KNOB
⑫BUSHING
INTENSITY
FOCUS
TRACE ALIGN
PHONE
AC POWER
CENTER FREQUENCY
1000
MHz
TUNING
ZERO ADJ
PRESET
FINE
RF ATT (dB)
CAUTION
CENTER
REFERENCE LEVEL
140
dBμ
dBμ/m
INPUT
CAL OUT
DETECTION MODE
VIDEO FILTER
SCAN MODE
START/RESET
⑪KNOB
⑥KNOB
②PLATE, B.W.
③PLATE, IF GAIN (1dB step)

Rotary Switch (S1, SW51) ASSEMBLY

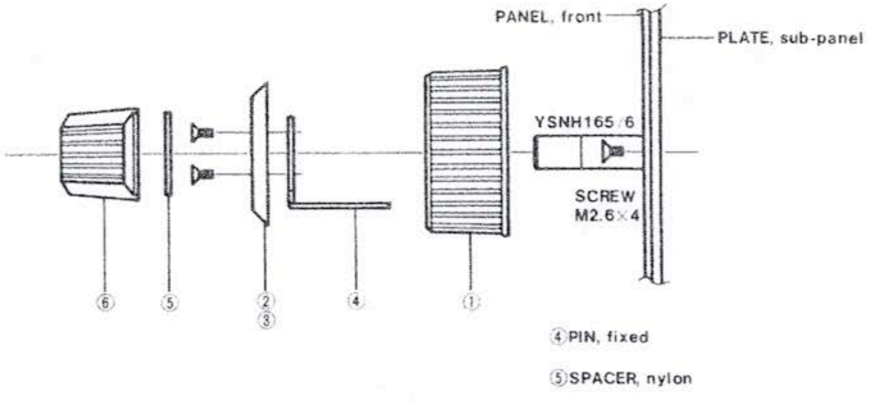

PANEL, front
PLATE, sub-panel
YSNH165/6
SCREW
M2.6×4
⑥
⑤
②
③
④
①
④PIN, fixed
⑤SPACER, nylon

Figure 7.1
ESA-1000 FRONT VIEW

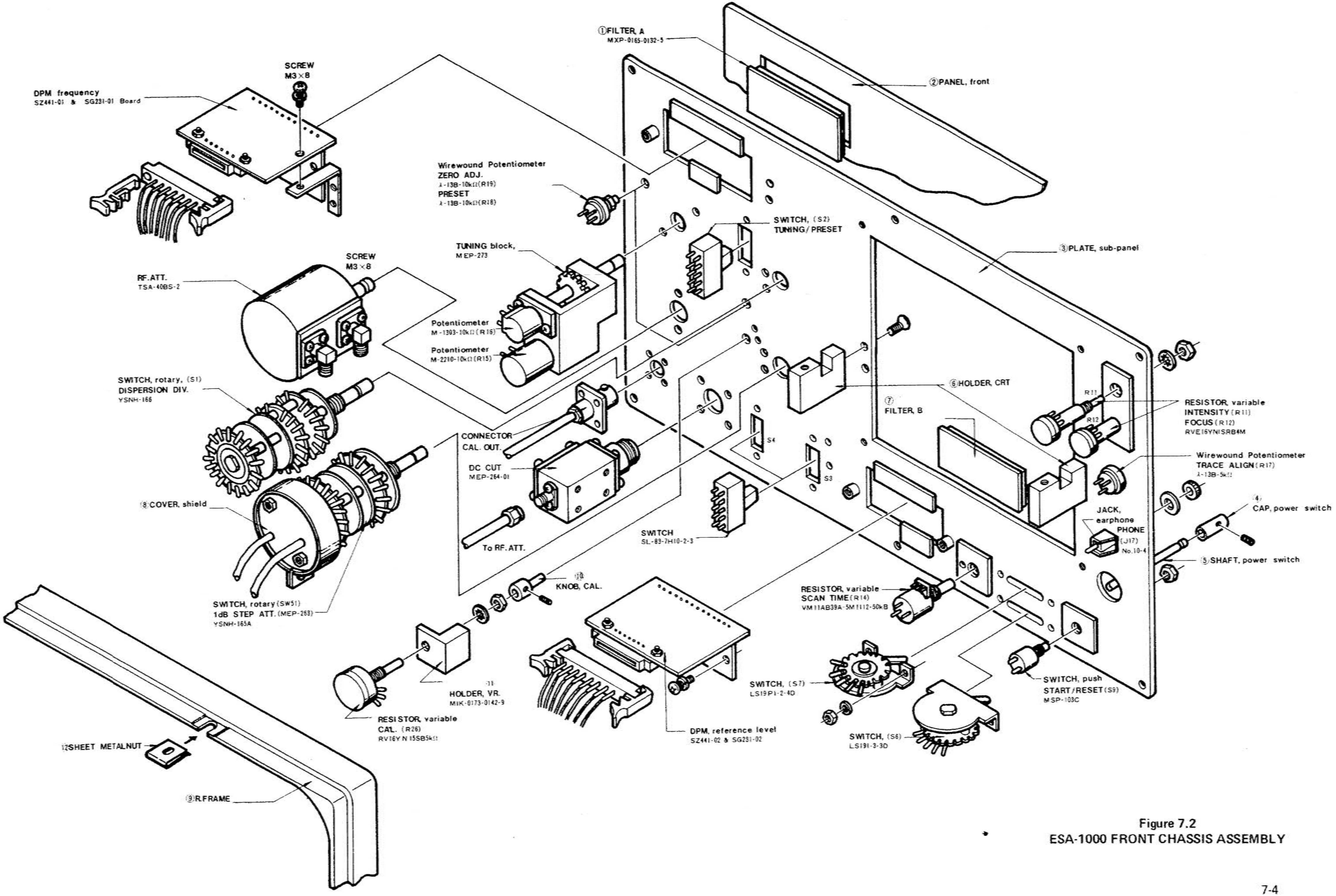

①FILTER, A
MXP-0165-0132-5
②PANEL, front
SCREW
M3×8
DPM frequency
SZ441-01 & SG231-01 Board
Wirewound Potentiometer
ZERO ADJ.
λ-13B-10kΩ(R19)
PRESET
λ-13B-10kΩ(R18)
SWITCH, (S2)
TUNING/PRESET
③PLATE, sub-panel
TUNING block,
MEP-273
SCREW
M3×8
RF.ATT.
TSA-40BS-2
Potentiometer
M-1303-10kΩ(R16)
Potentiometer
M-2210-10kΩ(R15)
SWITCH, rotary, (S1)
DISPERSION DIV.
YSNH-166
⑥HOLDER, CRT
⑦
FILTER, B
R11
R12
RESISTOR, variable
INTENSITY(R11)
FOCUS(R12)
RVE16YN1SRB4M
CONNECTOR
CAL. OUT.
DC CUT
MEP-264-01
S4
S3
Wirewound Potentiometer
TRACE ALIGN(R17)
λ-13B-5kΩ
⑧COVER, shield
JACK,
earphone
PHONE
(J17)
No.10-4
④
CAP, power switch
SWITCH
SL-89-7H10-2-3
To RF. ATT.
⑤SHAFT, power switch
⑩
KNOB, CAL.
RESISTOR, variable
SCAN TIME(R14)
VM11AB39A-5M1112-50kB
SWITCH, rotary(SW51)
1dB STEP ATT.(MEP-263)
YSNH-165A
⑪
HOLDER, VR.
MIK-0173-0142-9
SWITCH, (S7)
LS19P1-2-4D
SWITCH, push
START/RESET(S9)
MSP-103C
RESISTOR, variable
CAL. (R26)
RV16YN15SB5kΩ
DPM, reference level
SZ441-02 & SG231-02
SWITCH, (S6)
LS191-3-3D
⑫SHEET METALNUT
⑨R.FRAME

Figure 7.2
ESA-1000 FRONT CHASSIS ASSEMBLY

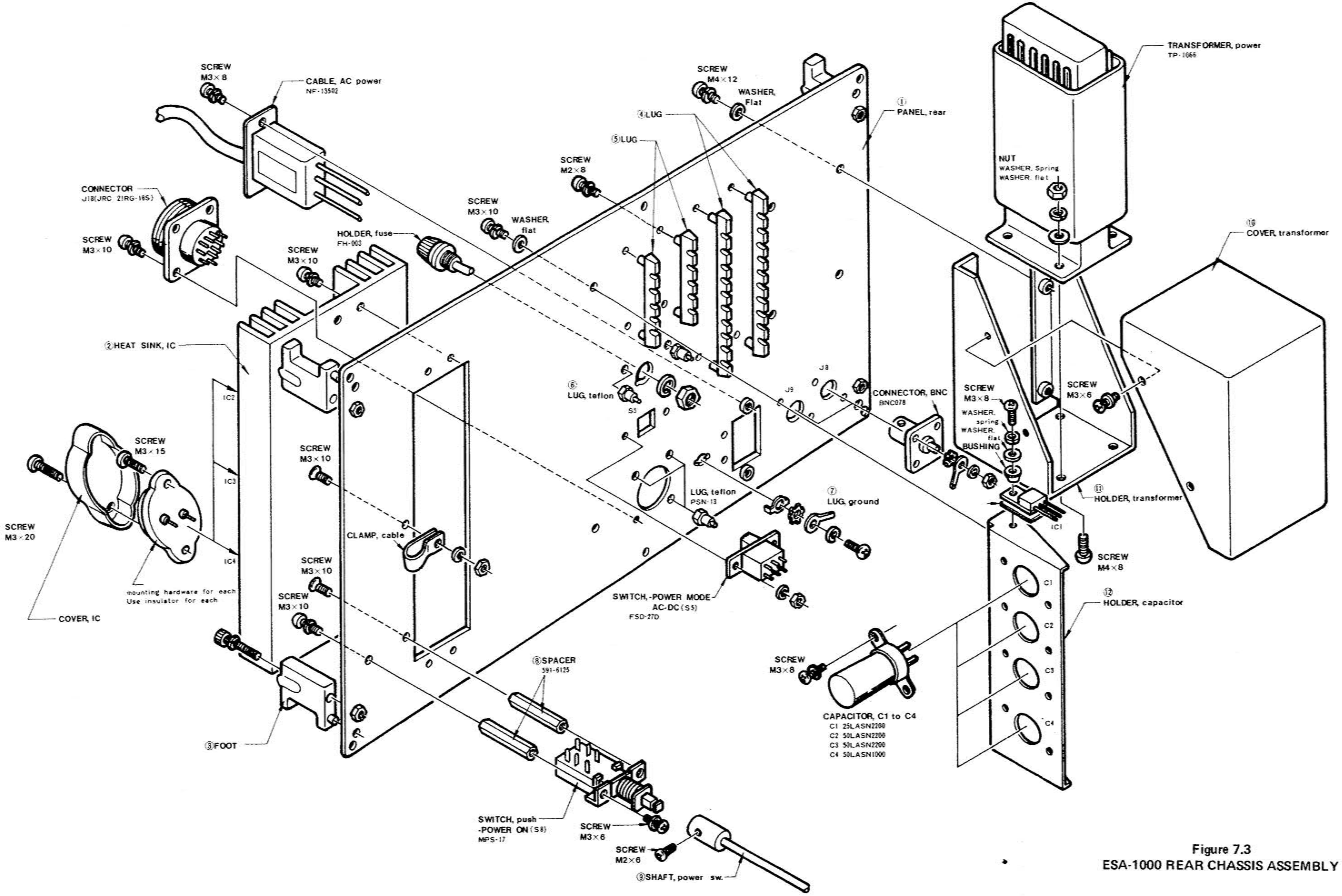

SCREW
M3×8
CABLE, AC power
NF-13502
SCREW
M4×12
WASHER, Flat
④LUG
⑤LUG
①
PANEL, rear
TRANSFORMER, power
TP-1066
CONNECTOR
J18(JRC 21RG-18S)
SCREW
M2×8
NUT
WASHER, Spring
WASHER, flat
⑩
COVER, transformer
SCREW
M3×10
SCREW
M3×10
WASHER, flat
HOLDER, fuse
FH-003
SCREW
M3×10
②HEAT SINK, IC
IC2
IC3
IC4
⑥
LUG, teflon
S5
J9
J8
CONNECTOR, BNC
BNC078
SCREW
M3×8
WASHER, spring
WASHER, flat
BUSHING
SCREW
M3×6
SCREW
M3×15
SCREW
M3×10
SCREW
M3×20
CLAMP, cable
LUG, teflon
PSN-13
⑦
LUG, ground
⑪
HOLDER, transformer
IC1
SCREW
M4×8
mounting hardware for each
Use insulator for each
COVER, IC
SCREW
M3×10
SCREW
M3×10
SWITCH,-POWER MODE
AC-DC (S5)
FSD-27D
⑫
HOLDER, capacitor
C1
C2
C3
C4
SCREW
M3×8
CAPACITOR, C1 to C4
C1 25LASN2200
C2 50LASN2200
C3 50LASN2200
C4 50LASN1000
⑧SPACER
591-6125
③FOOT
SWITCH, push
-POWER ON (S8)
MPS-17
SCREW
M3×6
SCREW
M2×6
⑨SHAFT, power sw.

Figure 7.3
ESA-1000 REAR CHASSIS ASSEMBLY

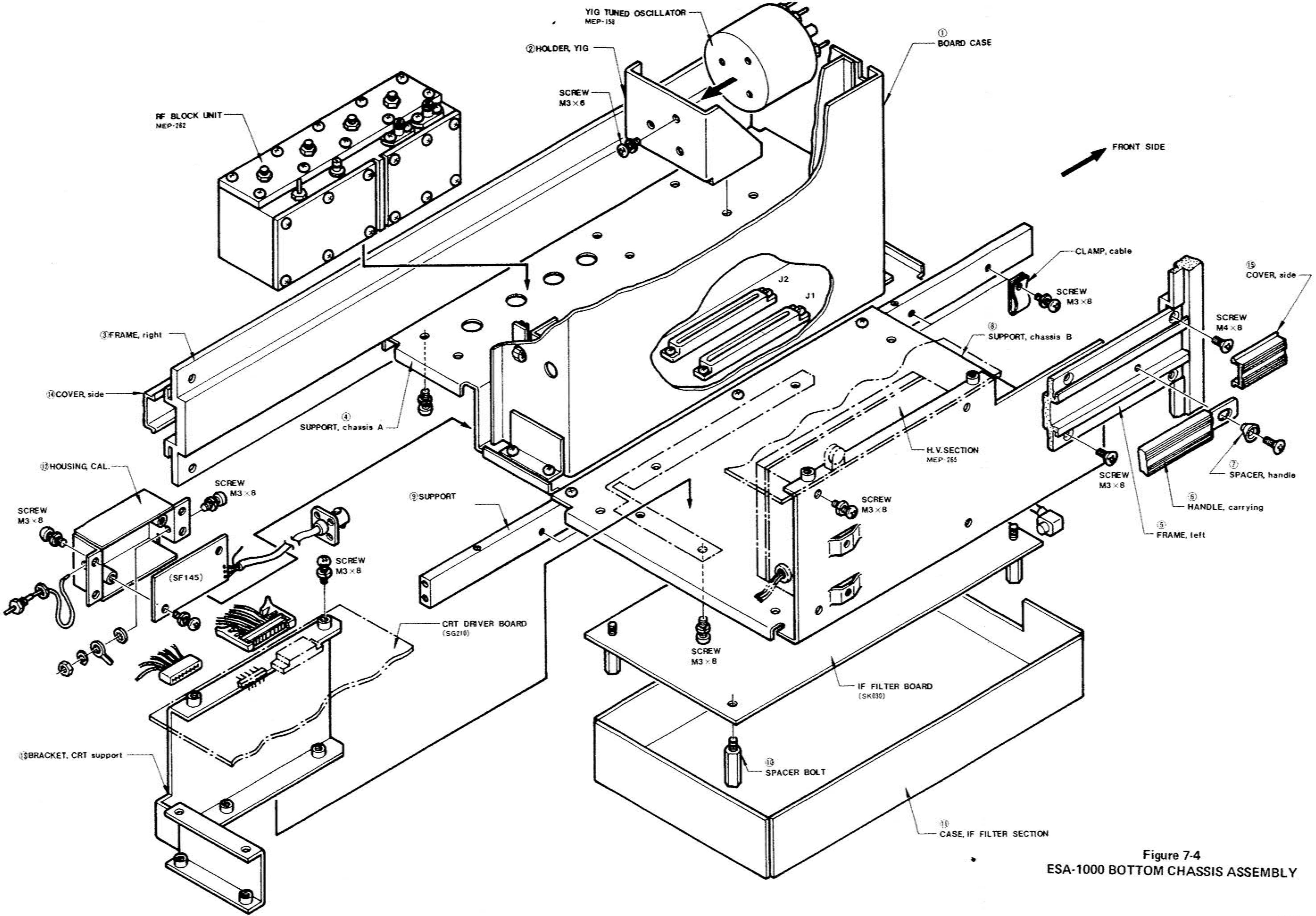

YIG TUNED OSCILLATOR
MEP-158
① BOARD CASE
② HOLDER, YIG
SCREW
M3×6
RF BLOCK UNIT
MEP-262
FRONT SIDE
CLAMP, cable
J2
J1
SCREW
M3×8
⑮ COVER, side
③ FRAME, right
⑧ SUPPORT, chassis B
SCREW
M4×8
⑭ COVER, side
④ SUPPORT, chassis A
H.V.SECTION
MEP-265
⑫ HOUSING, CAL.
SCREW
M3×8
SCREW
M3×8
⑦ SPACER, handle
⑨ SUPPORT
SCREW
M3×8
SCREW
M3×8
⑥ HANDLE, carrying
⑤ FRAME, left
(SF145)
SCREW
M3×8
CRT DRIVER BOARD
(SG210)
SCREW
M3×8
IF FILTER BOARD
(SK030)
⑬ BRACKET, CRT support
⑩ SPACER BOLT
⑪ CASE, IF FILTER SECTION

Figure 7-4
ESA-1000 BOTTOM CHASSIS ASSEMBLY

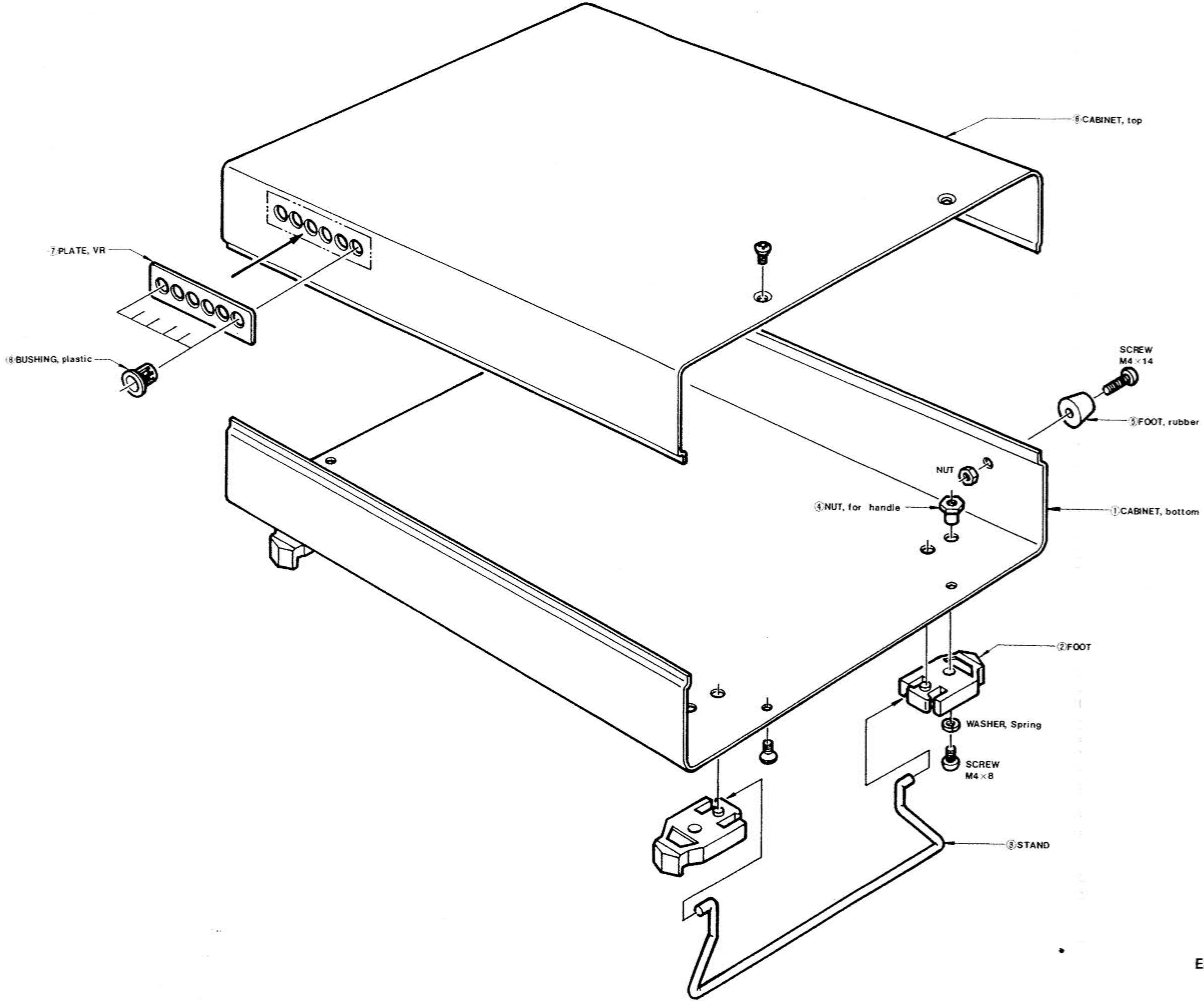

⑥CABINET, top
⑦PLATE, VR
⑧BUSHING, plastic
SCREW
M4×14
⑤FOOT, rubber
NUT
④NUT, for handle
①CABINET, bottom
②FOOT
WASHER, Spring
SCREW
M4×8
③STAND

Figure 7.5
ESA-1000 COVERS ASSEMBLY

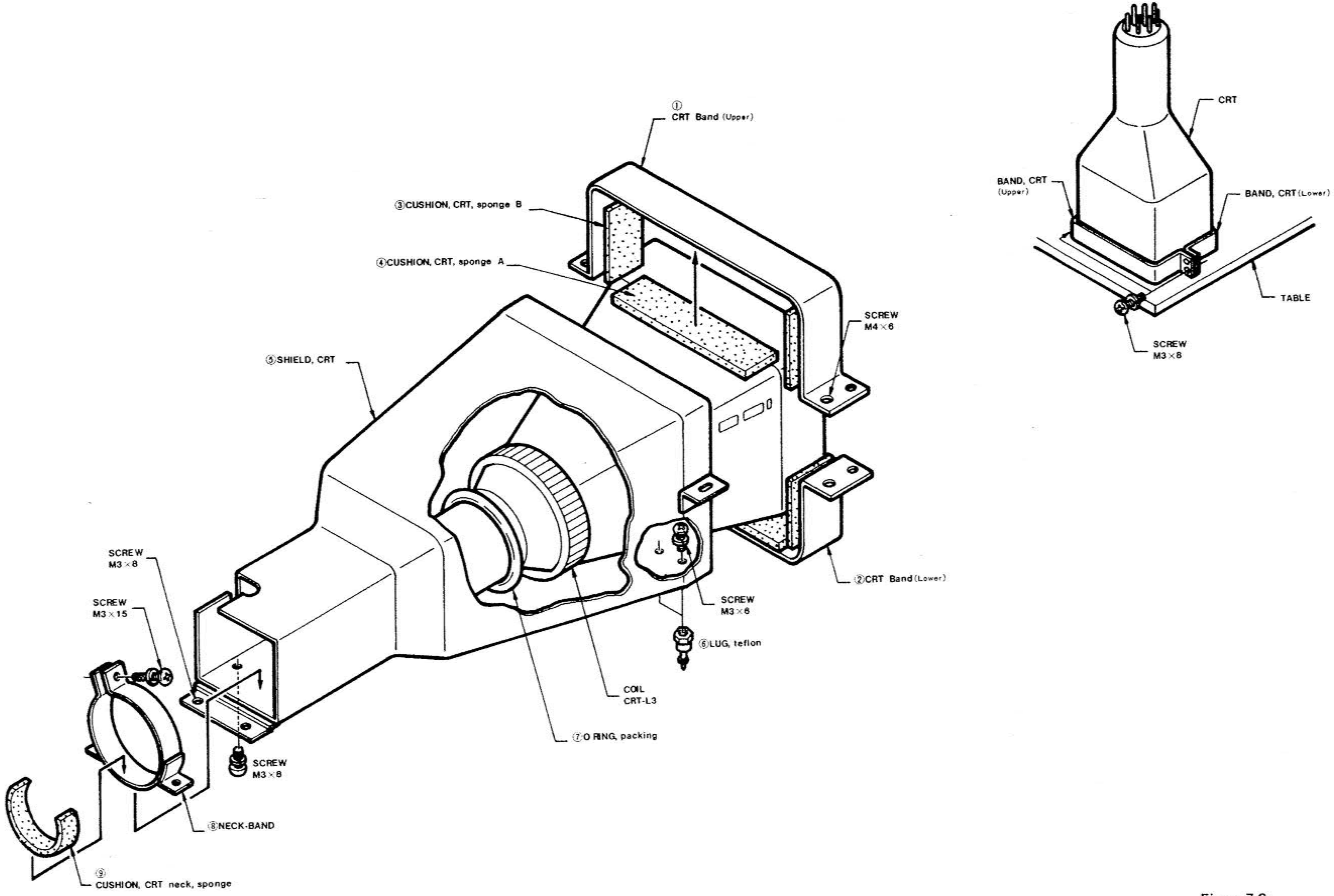

①
CRT Band (Upper)
③CUSHION, CRT, sponge B
④CUSHION, CRT, sponge A
⑤SHIELD, CRT
SCREW
M4 × 6
②CRT Band (Lower)
SCREW
M3 × 6
⑥LUG, teflon
COIL
CRT-L3
⑦O RING, packing
SCREW
M3 × 8
SCREW
M3 × 15
SCREW
M3 × 8
⑧NECK-BAND
⑨
CUSHION, CRT neck, sponge
CRT
BAND, CRT
(Upper)
BAND, CRT (Lower)
TABLE
SCREW
M3 × 8

Figure 7.6
ESA-1000 CRT & SHIELD ASSEMBLY

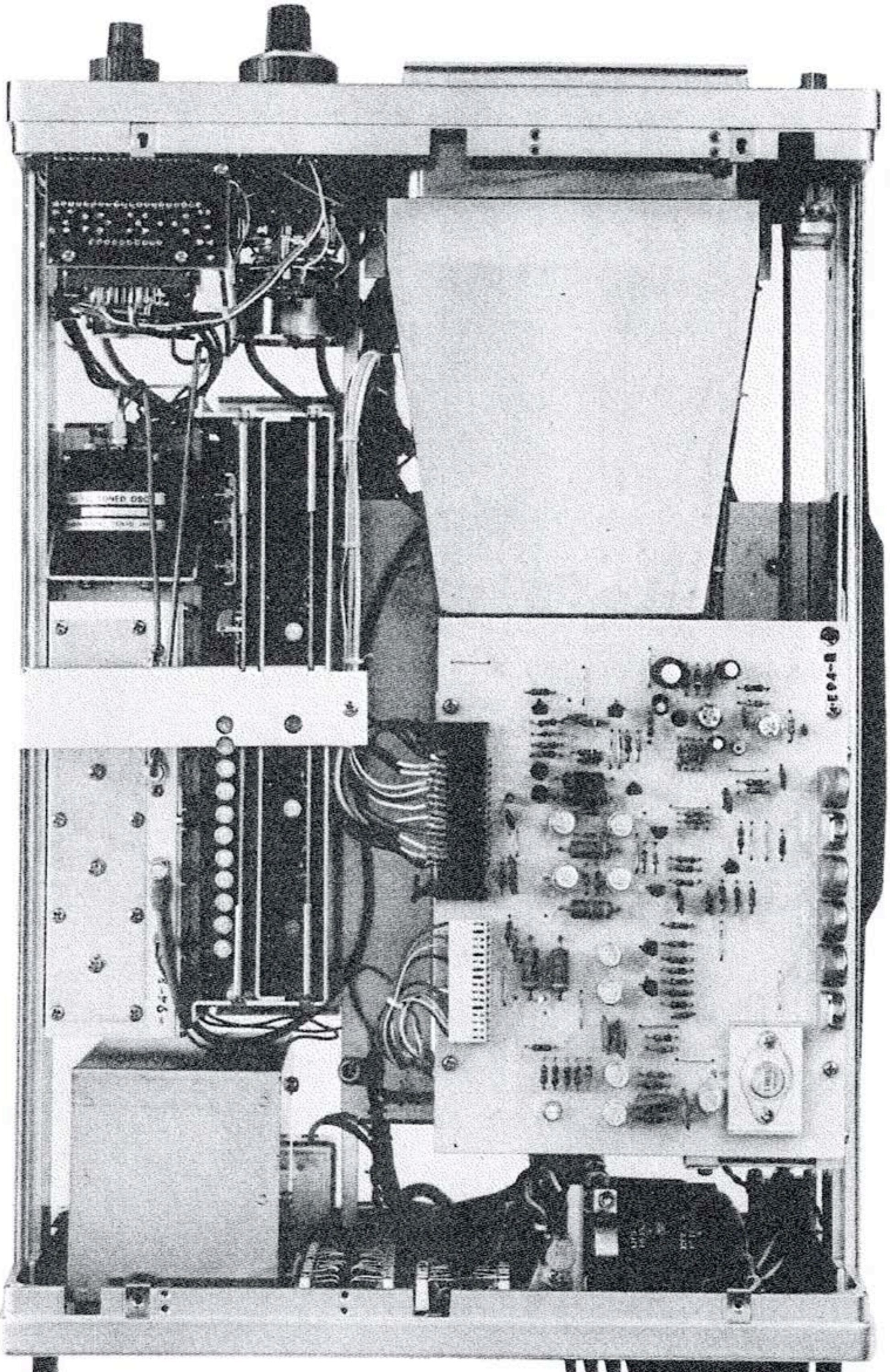
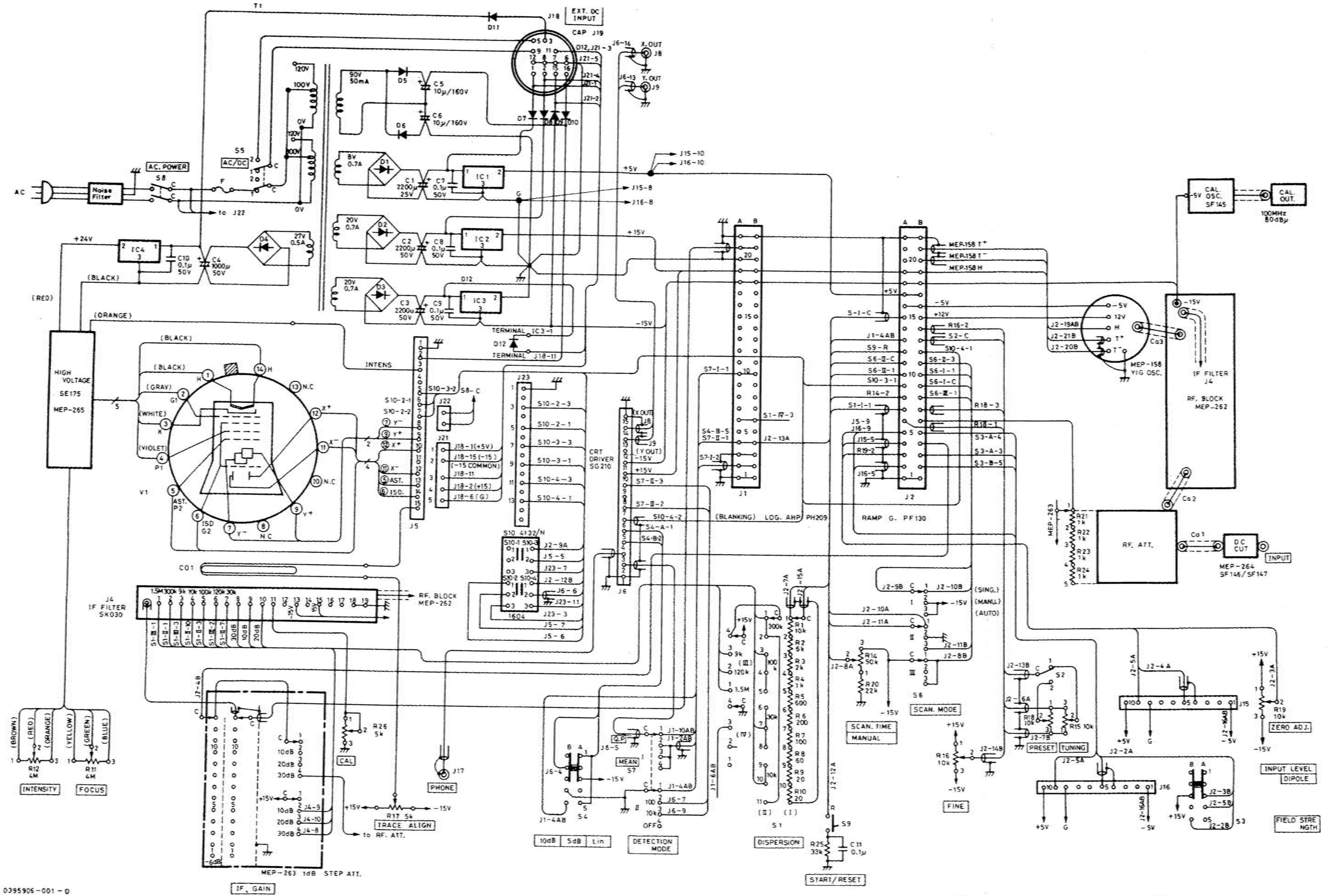


Figure 7.7 ESA-1000 TOP VIEW


T1
D11
J18
EXT. DC INPUT
CAP J19
X OUT J8
Y OUT J9
AC
Noise Filter
AC. POWER
S8
S5
AC/DC
to J22
90V 50mA
C5 10μ/160V
C6 10μ/160V
8V 0.7A
IC 1
C1 2200μ 25V
C7 0.1μ 50V
20V 0.7A
IC 2
C2 2200μ 50V
C8 0.1μ 50V
IC 3
C3 2200μ 50V
C9 0.1μ 50V
+24V
IC4
C10 0.1μ 50V
C4 1000μ 50V
27V 0.5A
+5V
+15V
-15V
J15-10
J16-10
J15-8
J16-8
HIGH VOLTAGE SE175 MEP-265
V1
INTENS
J5
J21
J22
J23
CRT DRIVER SG210
S10 4132/N
J1
(BLANKING) LOG. AMP PH209
J2
RAMP G. PF130
J6
MEP-158 YIG OSC.
CAL. OSC. SF145
CAL. OUT.
100MHz 80dBμ
IF FILTER J4
RF. BLOCK MEP-262
RF. ATT.
DC CUT
INPUT
MEP-264 SF146/SF147
MEP-263
J4 IF FILTER SK030
RF. BLOCK MEP-262
INTENSITY
FOCUS
R12 4M
R11 4M
MEP-263 1dB STEP ATT.
IF. GAIN
CAL
R26 5k
PHONE
J17
R17 5k
TRACE ALIGN
to RF. ATT.
10dB
5dB
Lin
S4
DETECTION MODE
S7
Q.P
MEAN
DISPERSION
S1
START/RESET
S9
R25 33k
C11 0.1μ
SCAN. TIME MANUAL
R14 50k
R20 22k
S6
SCAN. MODE
(SING.)
(MANU.)
(AUTO)
R16 10k
FINE
S2
PRESET
TUNING
R18 10k
R15 10k
J15
J16
ZERO ADJ.
R19 10k
INPUT LEVEL DIPOLE
S3
FIELD STRENGTH

0395906-001-D

Figure 7.8
CONTROL SECTION

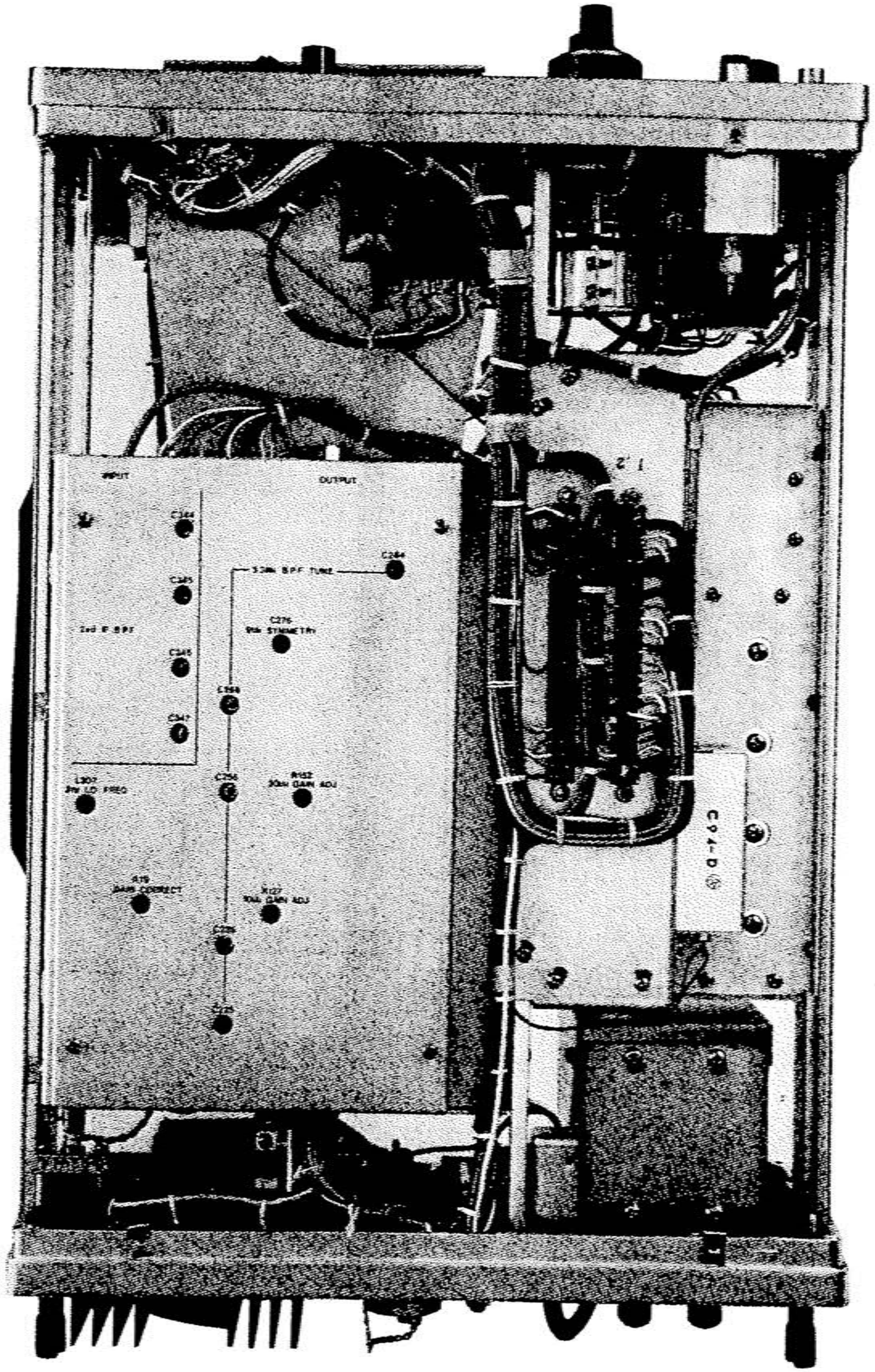

INPUT
OUTPUT
C344
C345
2nd IF BPF
C346
C347
BPF TUNE
C244
C276
SYMMETRY
L307
LO FREQ
C256
R152
GAIN ADJ
GAIN CORRECT
R127
GAIN ADJ

Figure 7.9 ESA-1000 BOTTOM VIEW

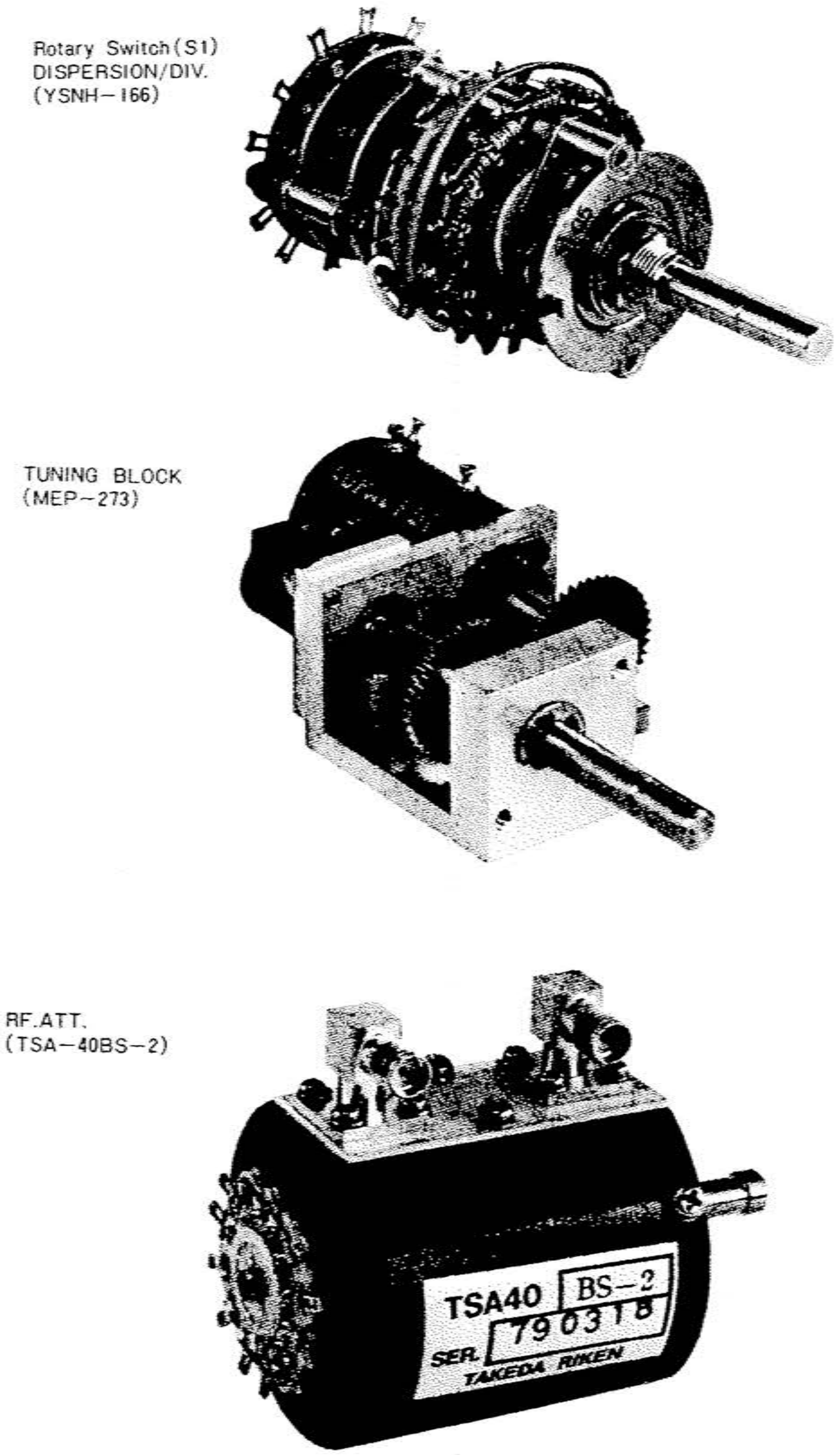
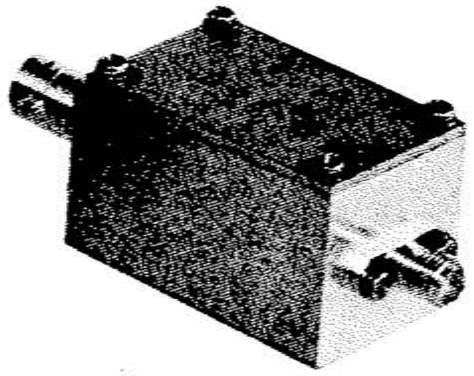
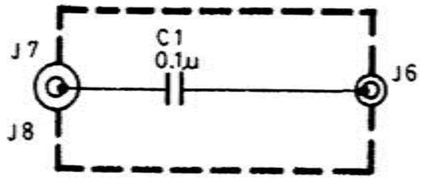

Rotary Switch(S1)
DISPERSION/DIV.
(YSNH-166)
TUNING BLOCK
(MEP-273)
RF.ATT.
(TSA-40BS-2)
TSA40
BS-2
SER.
790318
TAKEDA RIKEN

Figure 7.10 ROTARY SWITCH, RF TUNING BLOCK, RF ATTENUATOR ASSEMBLIES



DC BLOCKING ASSEMBLY
MEP-264-01/02

Figure 7.11 DC BLOCKING ASSEMBLY


J7
J8
C1
0.1µ
J6

0395906 – 003 – B

Figure 7.12
DC BLOCKING CKT
MEP-264-01

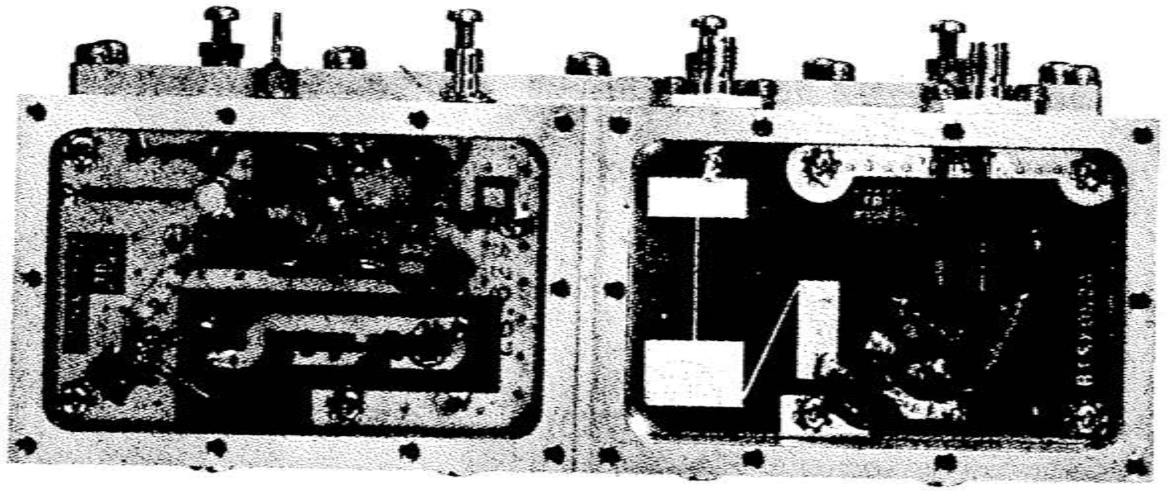


Figure 7.13 1ST MIXER ASSEMBLY (SX052)

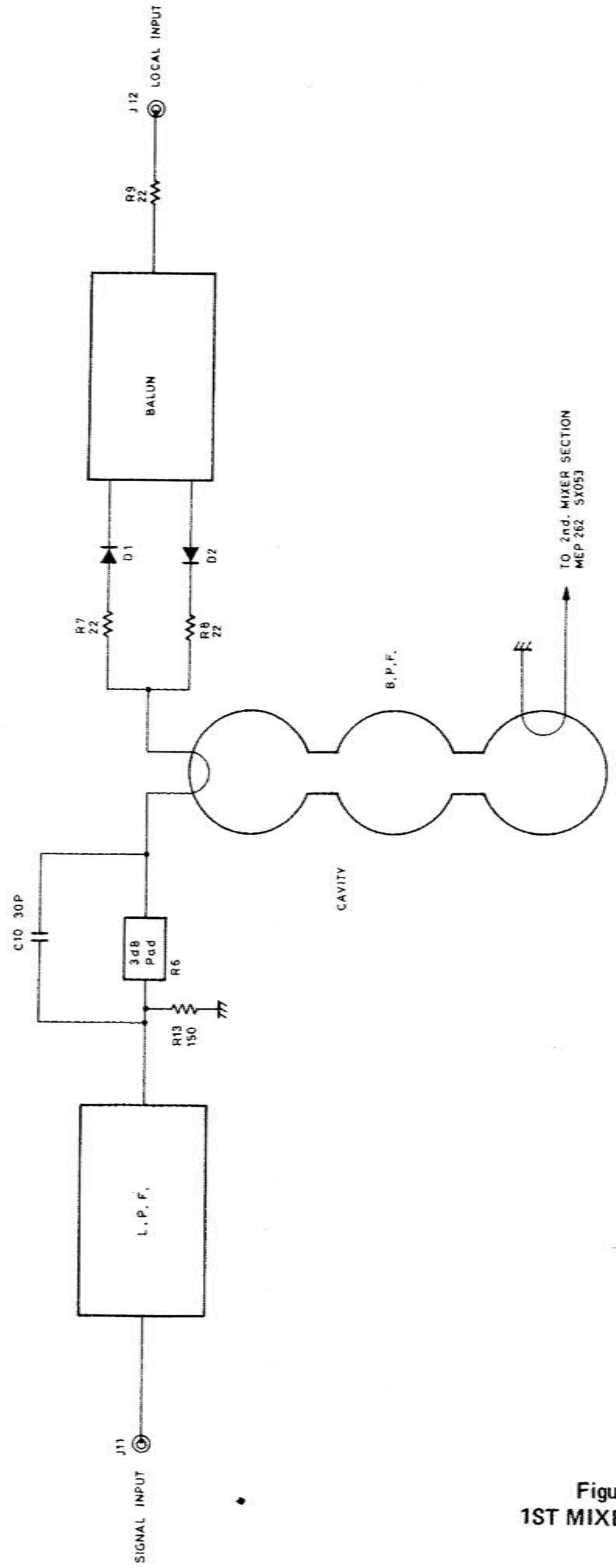

LOCAL INPUT
J12
R9
22
BALUN
D1
D2
R7
22
R8
22
TO 2nd. MIXER SECTION
MEP 262 SX053
B.P.F.
CAVITY
C10 30P
3dB
Pad
R6
R13
150
L.P.F.
J11
SIGNAL INPUT

Figure 7.14
1ST MIXER CIRCUIT

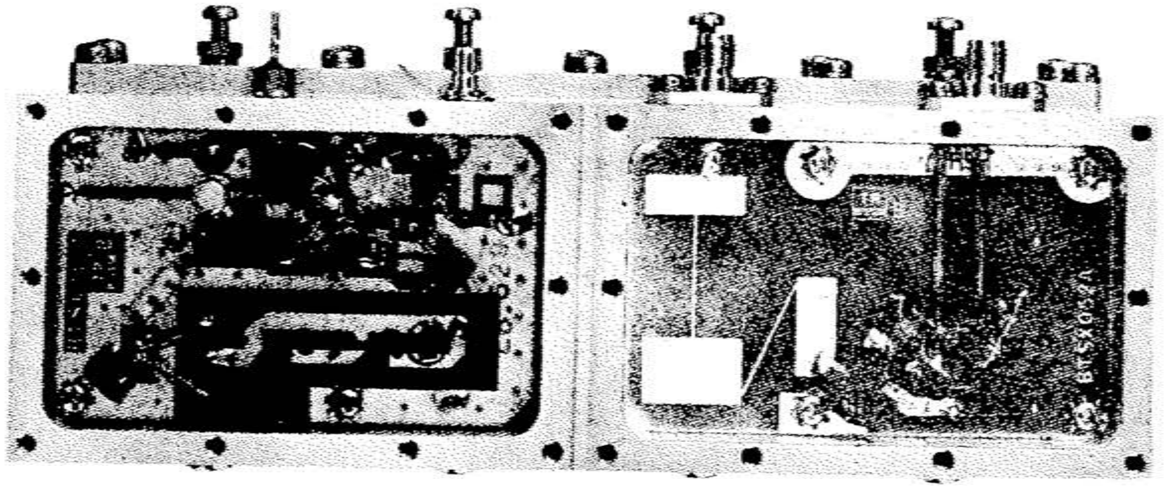


Figure 7.15 2ND MIXER ASSEMBLY (SX053)

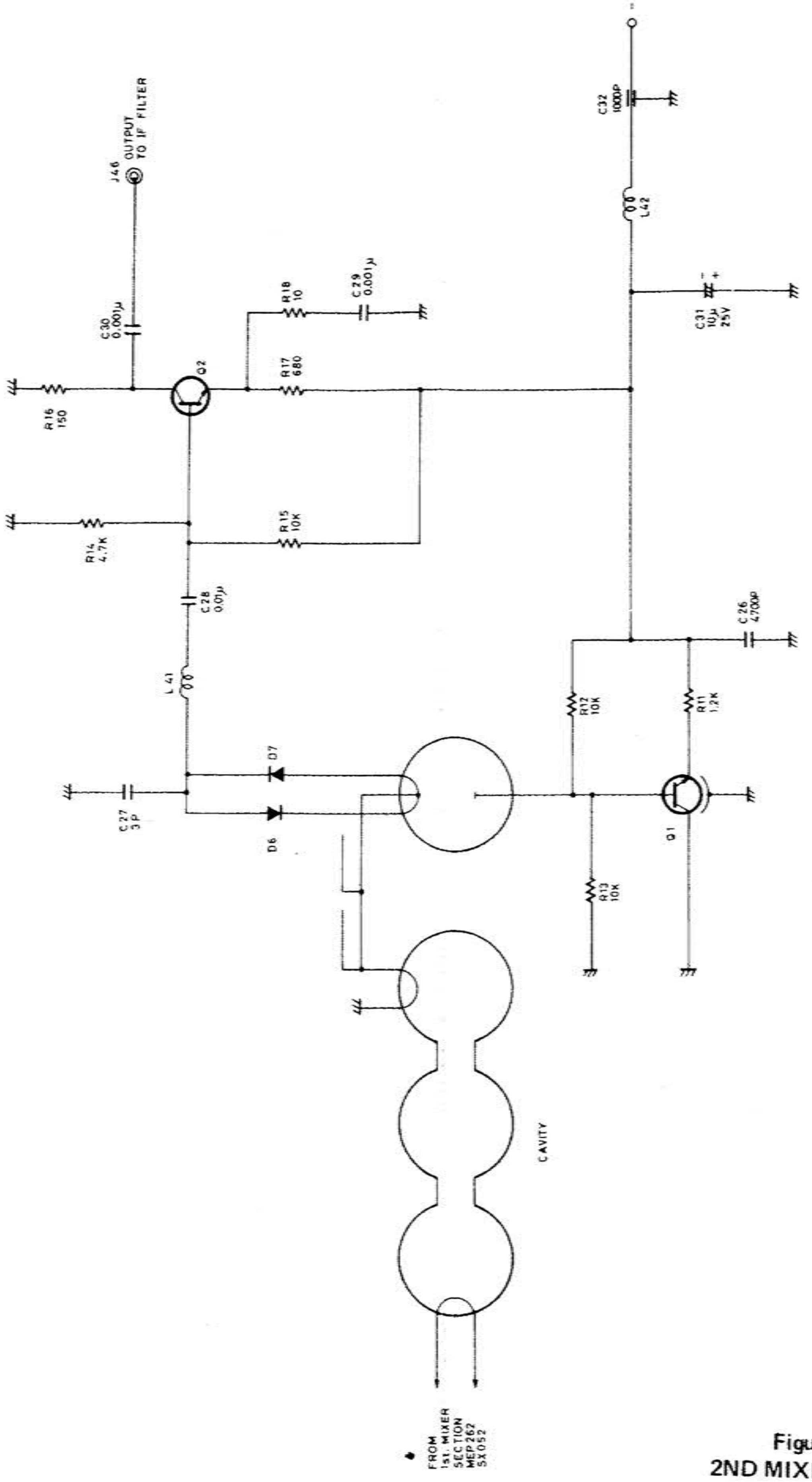

-15V
C32
1000P
L42
C31
10µ
25V
J46
OUTPUT
TO IF FILTER
C30
0.001µ
R18
10
C29
0.001µ
Q2
R17
680
R16
150
R15
10K
R14
4.7K
C28
0.01µ
C26
4700P
L41
R12
10K
R11
1.2K
D7
D6
C27
3P
Q1
R13
10K
CAVITY
FROM
1st. MIXER
SECTION
MEP262
SX052

Figure 7.16
2ND MIXER CIRCUIT

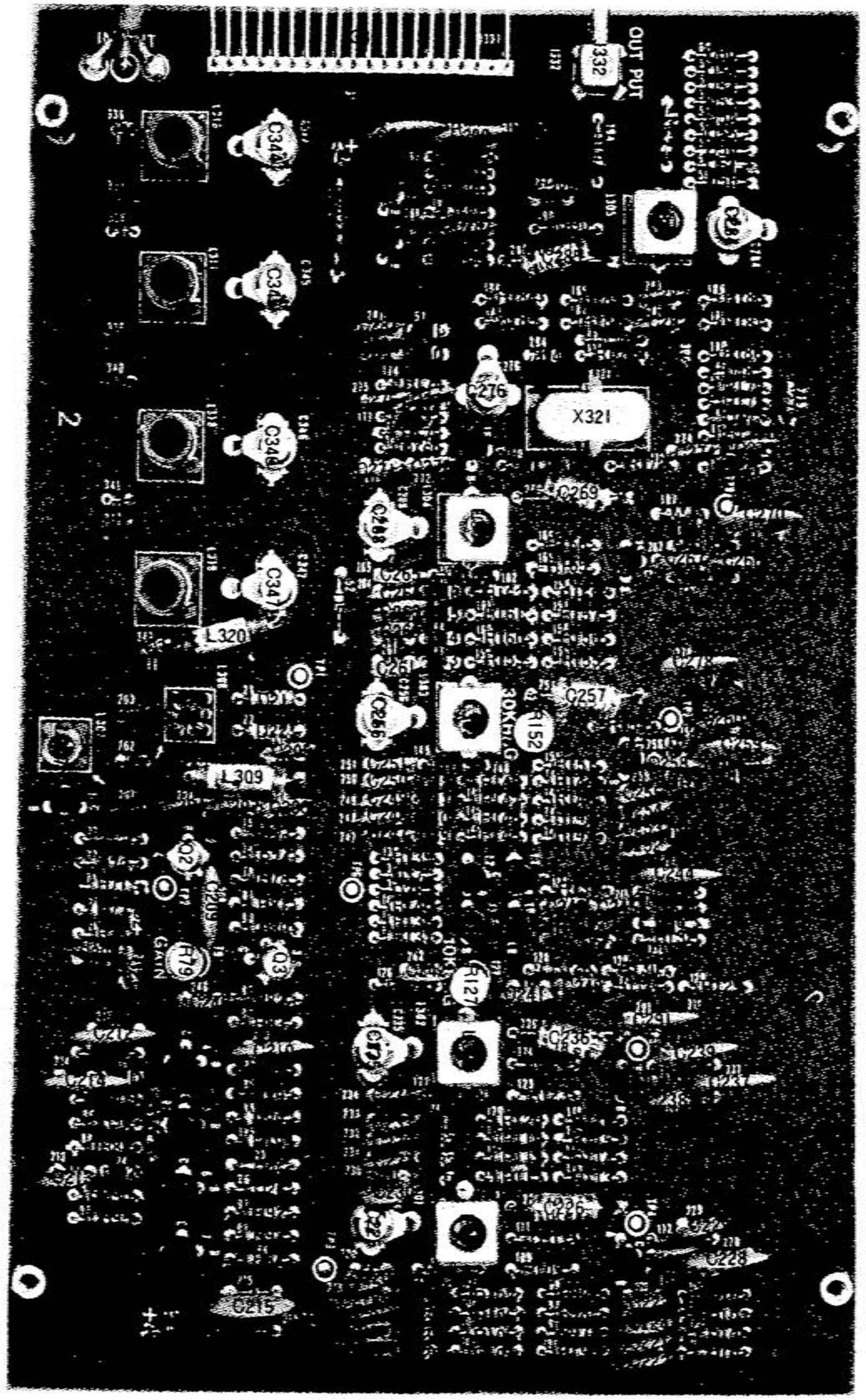
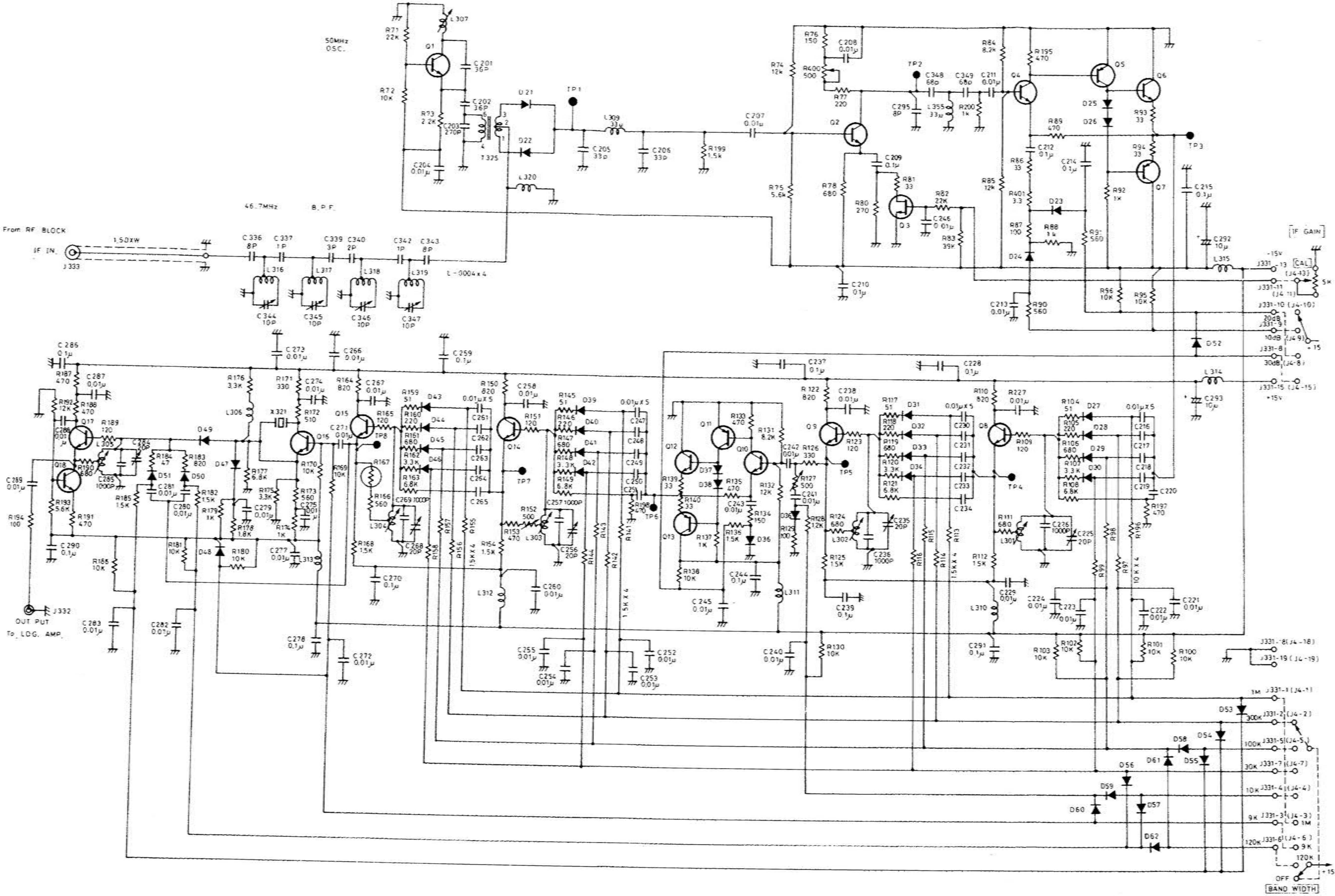

OUT PUT
332
C344
C343
C348
C347
L320
L309
X321
C276
C269
C268
C257
C266
R152
Q2
Q3
R79
GAIN
C215
2

Figure 7.17 IF FILTER Bd LAYOUT (SK030)



50MHz OSC.
L307
R71 22K
Q1
C201 36P
R72 10K
C202 36P
R73 2.2K
C203 270P
C204 0.01μ
T325
D21
D22
TP1
L309 33μ
C205 33p
C206 33p
R199 1.5K
C207 0.01μ
L320
46.7MHz
B.P.F.
From RF BLOCK
IF IN
J333
1.5DXW
C336 8P
C337 1P
C339 3P
C340 2P
C342 1P
C343 8P
L316
L317
L318
L319
L-0004x4
C344 10P
C345 10P
C346 10P
C347 10P
R76 150
C208 0.01μ
R74 12k
R400 500
R77 220
TP2
C348 68p
C349 68p
C211 0.01μ
C295 8P
L355 33μ
R200 1k
Q2
R75 5.6k
R78 680
C209 0.1μ
R81 33
R80 270
Q3
R82 22K
C246 0.01μ
R83 39K
C210 0.1μ
R84 8.2k
R195 470
Q4
Q5
Q6
D25
D26
R93 33
R89 470
TP3
C212 0.1μ
R86 33
C214 0.1μ
R94 33
Q7
R85 12k
R401 3.3
R92 1K
C215 0.1μ
D23
R87 100
R88 1k
R91 560
C292 10μ
D24
L315
IF GAIN
J331-13
CAL
(J4-13)
5K
-15V
J331-11 (J4-11)
C213 0.01μ
R90 560
R96 10K
R95 10K
J331-10 (J4-10)
20dB
J331-9
10dB (J4-9)
D52
+15
J331-8
30dB (J4-8)
L314
J331-15 (J4-15)
+15V
C293 10μ
C286 0.1μ
R187 470
C287 0.01μ
R192 12K
R188 470
Q17
C288 0.01μ
R189 120
L305
C284 20P
R184 47
R183 820
D49
Q18
R190 680
C285 1000P
D51
D50
C281 0.01μ
C289 0.01μ
R193 5.6K
R191 470
R185 1.5K
C280 0.01μ
R182 1.5K
R194 100
C290 0.1μ
R186 10K
R181 10K
D48
R180 10K
OUT PUT
To LOG. AMP.
J332
C283 0.01μ
C282 0.01μ
C273 0.01μ
C266 0.01μ
C259 0.1μ
R176 3.3K
R171 330
C274 0.01μ
R164 820
C267 0.01μ
L306
X321
R172 510
Q15
Q16
C271 0.01μ
R165 120
TP8
D47
R177 6.8K
R170 10K
R169 10K
R167
R175 3.3K
C279 0.01μ
R173 560
C275 0.01μ
R179 1K
R178 1.8K
R174 1K
C277 0.01μ
L313
R166 560
L304
C269 1000P
C268 20P
R168 1.5K
C270 0.1μ
C278 0.1μ
C272 0.01μ
R159 51
D43
R160 220
D44
R161 680
D45
R162 3.3K
D46
R163 6.8K
R158
R157
R156
R155
1.5Kx4
R150 820
0.01μx5
C261
C262
C263
C264
C265
C258 0.01μ
Q14
R151 120
TP7
R152 500
L303
R153 470
C257 1000P
C256 20P
R154 1.5K
L312
C260 0.01μ
R145 51
D39
R146 220
D40
R147 680
D41
R148 3.3K
D42
R149 6.8K
R144
R143
R142
R141
1.5Kx4
C247
C248
C249
C250
C251
R198 470
TP6
C255 0.01μ
C254 0.01μ
C252 0.01μ
C253 0.01μ
Q11
Q12
Q10
Q13
R133 470
R131 8.2K
R139 33
D37
D38
R135 470
R140 33
C243 0.01μ
R134 150
R132 12K
R137 1K
R136 1.5K
D36
R138 10K
C244 0.1μ
L311
C245 0.01μ
C240 0.01μ
R130 10K
C237 0.1μ
C228 0.1μ
R122 820
C238 0.01μ
Q9
C242 0.01μ
R126 330
R123 120
TP5
R127 500
C241 0.01μ
D35
R129 100
R128 12K
R124 680
L302
C235 20P
C236 1000P
R125 1.5K
C239 0.1μ
R117 51
D31
R118 220
D32
R119 680
D33
R120 3.3K
D34
R121 6.8K
C230
C231
C232
C233
C234
R116
R115
R114
R113
1.5Kx4
R110 820
R227 0.01μ
Q8
R109 120
TP4
R111 680
L301
C276 1000P
C225 20P
R112 1.5K
C229 0.01μ
L310
C291 0.1μ
C224 0.01μ
C223 0.01μ
R103 10K
R102 10K
R104 51
D27
R105 220
D28
R106 680
D29
R107 3.3K
D30
R108 6.8K
C216
C217
C218
C219
C220
R197 470
R196
R98
R99
R97
10Kx4
C222 0.01μ
C221 0.01μ
R101 10K
R100 10K
J331-18 (J4-18)
J331-19 (J4-19)
1M J331-1 (J4-1)
D53
300K J331-2 (J4-2)
D54
D58
100K J331-5 (J4-5)
D61
D55
30K J331-7 (J4-7)
D56
D59
10K J331-4 (J4-4)
D60
D57
9K J331-3 (J4-3)
1M
D62
120K J331-6 (J4-6)
9K
120K
OFF
+15V
BAND WIDTH

Figure 7.18
IF FILTER CIRCUIT

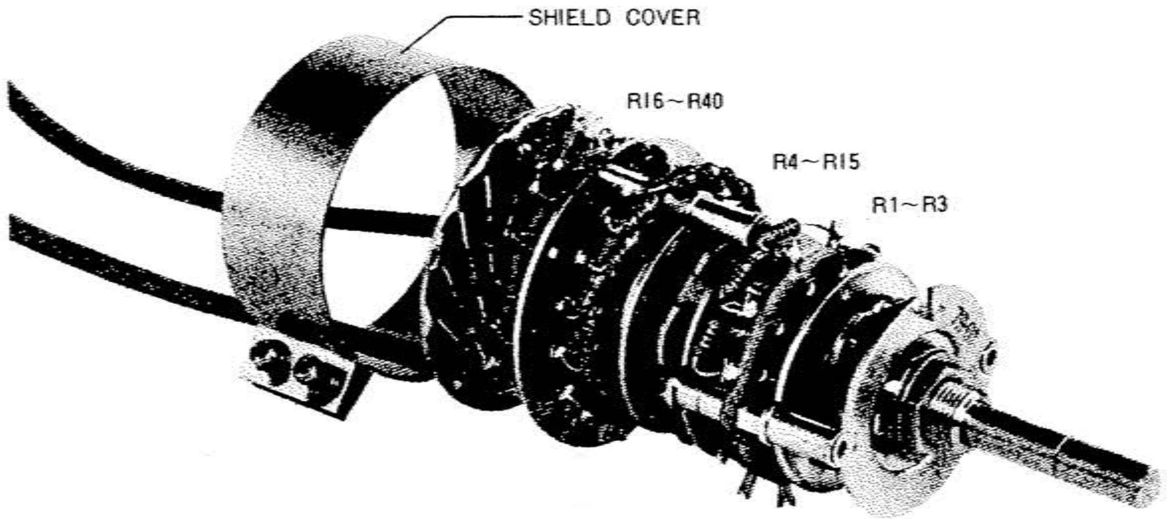
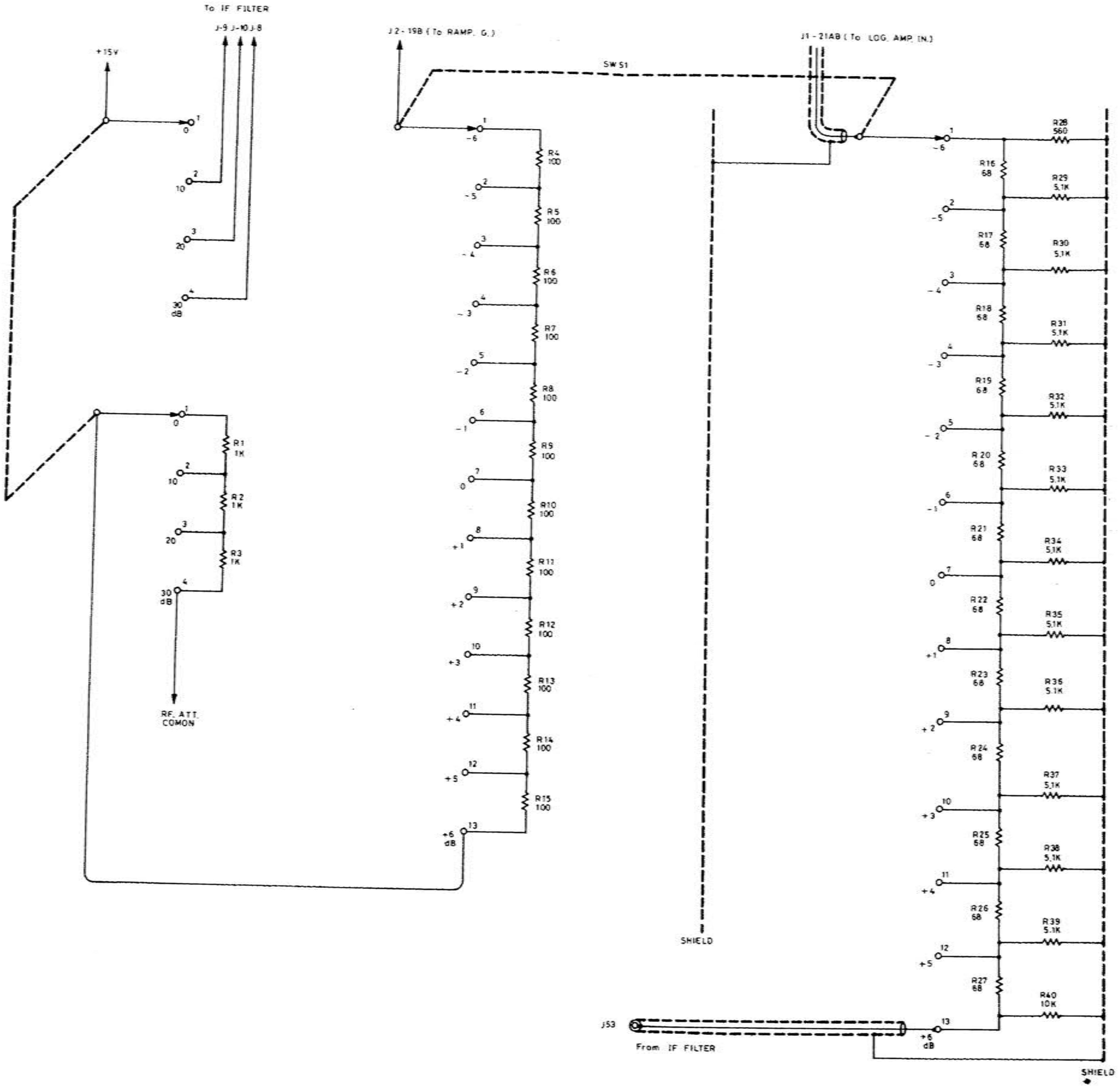

SHIELD COVER
R16~R40
R4~R15
R1~R3

Figure 7.19 1 dB STEP ATTENUATOR SWITCH ASSEMBLY (MEP-263)



To IF FILTER
J-9 J-10 J-8
+15V
J2 - 19B (To RAMP. G.)
SW S1
J1 - 21AB (To LOG. AMP. IN.)
0
10
20
30 dB
R1 1K
R2 1K
R3 1K
RF. ATT. COMON
-6
-5
-4
-3
-2
-1
0
+1
+2
+3
+4
+5
+6 dB
R4 100
R5 100
R6 100
R7 100
R8 100
R9 100
R10 100
R11 100
R12 100
R13 100
R14 100
R15 100
SHIELD
R28 560
R16 68
R29 5.1K
R17 68
R30 5.1K
R18 68
R31 5.1K
R19 68
R32 5.1K
R 20 68
R33 5.1K
R21 68
R34 5.1K
R22 68
R35 5.1K
R23 68
R36 5.1K
R24 68
R37 5.1K
R25 68
R38 5.1K
R26 68
R39 5.1K
R27 68
R40 10K
J53
From IF FILTER
SHIELD

Figure 7.20
1 dB STEP ATTENUATOR CIRCUIT

0395906-007-A

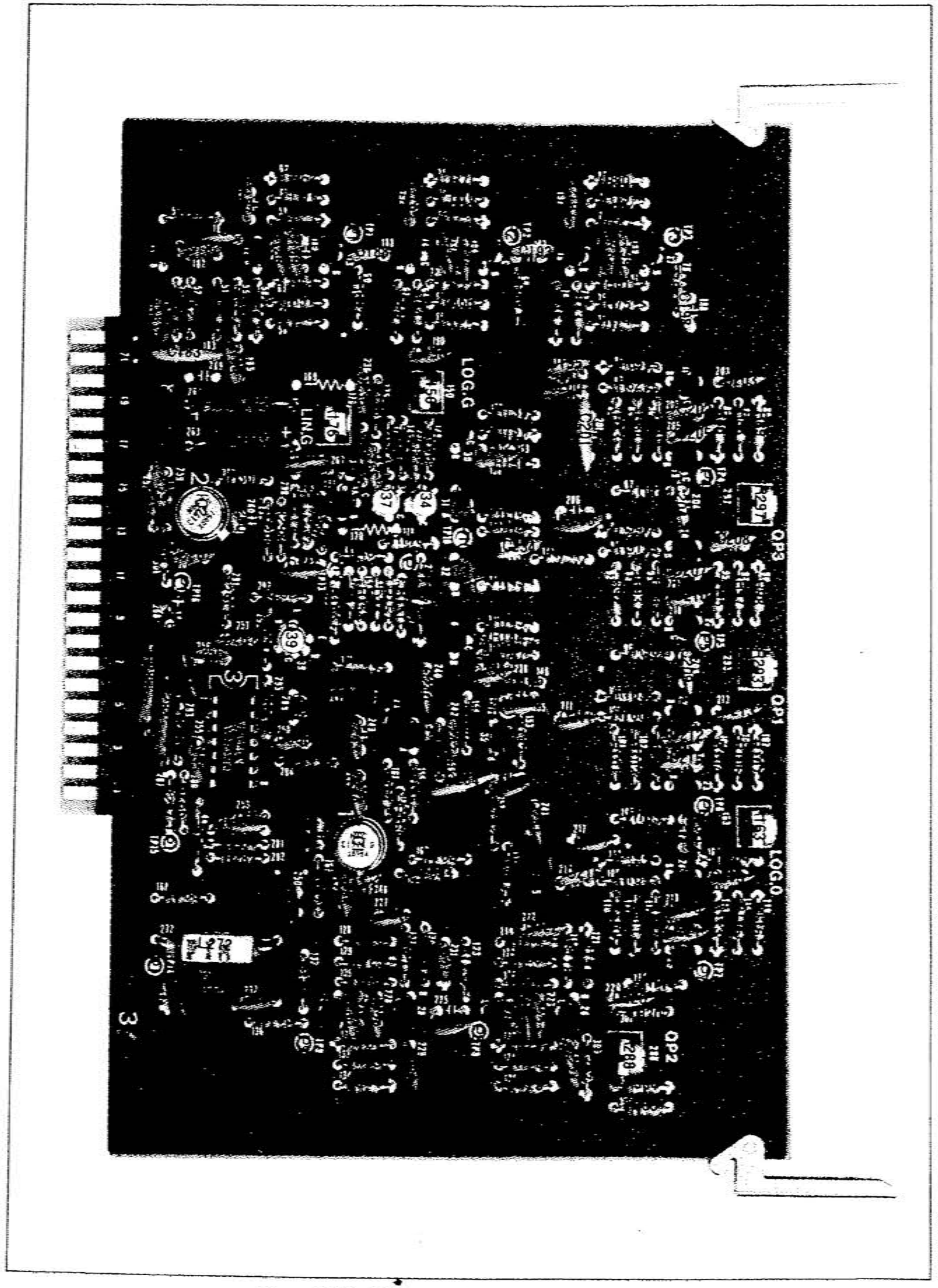

LOG.G
LIN.G
OP3
OP1
LOG.O
OP2

Figure 7.21 LOG AMP Bd LAYOUT (PH209)

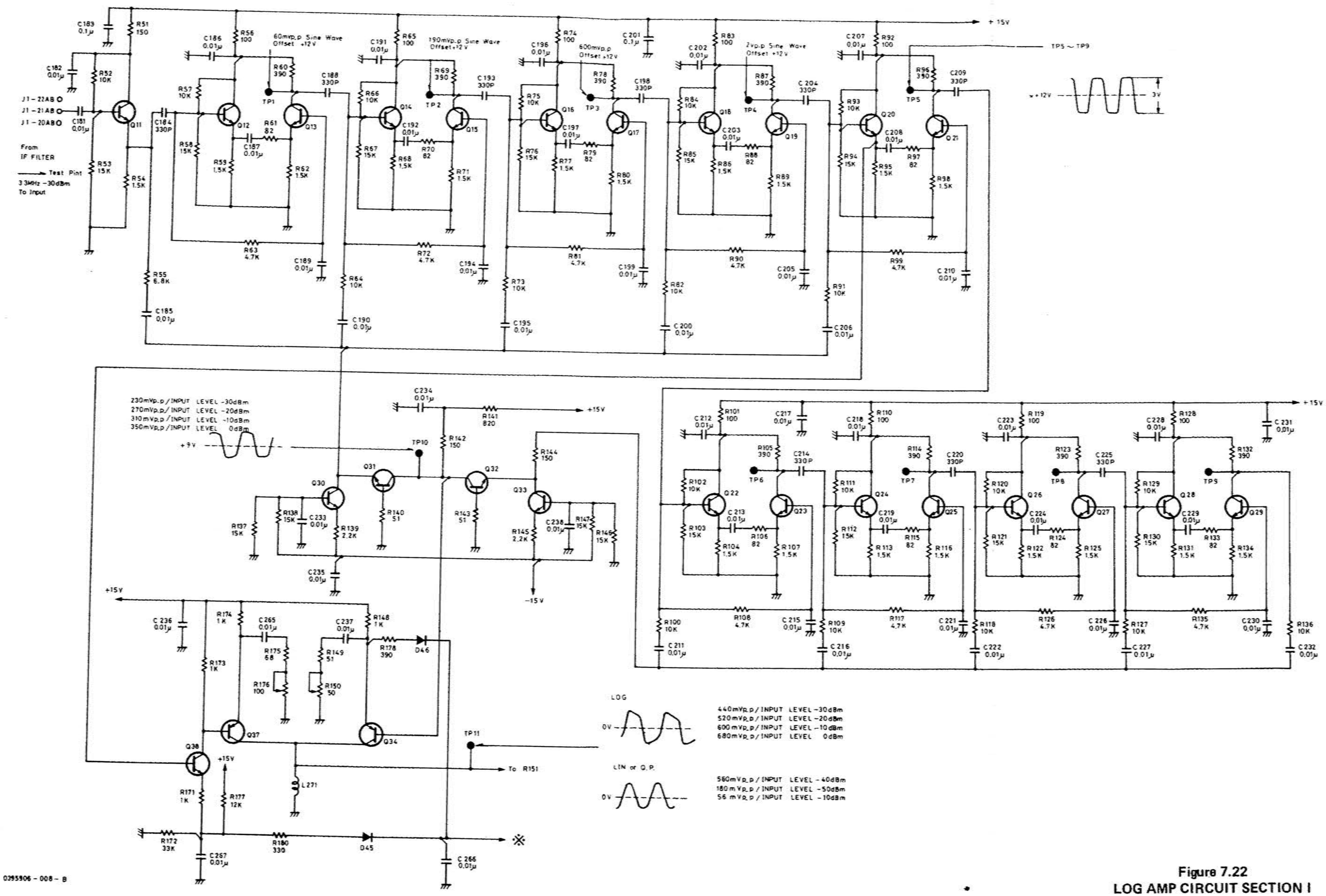

C183 0.1μ
R51 150
C182 0.01μ
R52 10K
J1-22AB
J1-21AB
J1-20AB
C181 0.01μ
Q11
From IF FILTER
Test Pint
3.3MHz -30dBm To Input
R53 15K
R54 1.5K
C184 330P
R55 6.8K
C185 0.01μ
C186 0.01μ
R56 100
60mVp.p Sine Wave Offset +12V
R57 10K
Q12
R60 390
TP1
C188 330P
Q13
R58 15K
R59 1.5K
C187 0.01μ
R61 82
R62 1.5K
R63 4.7K
C189 0.01μ
R64 10K
C190 0.01μ
C191 0.01μ
R65 100
190mVp.p Sine Wave Offset +12V
R66 10K
Q14
R69 390
TP2
C193 330P
Q15
C192 0.01μ
R67 15K
R68 1.5K
R70 82
R71 1.5K
R72 4.7K
C194 0.01μ
R73 10K
C195 0.01μ
C196 0.01μ
R74 100
600mVp.p Offset +12V
C201 0.1μ
R75 10K
Q16
R78 390
TP3
C198 330P
Q17
C197 0.01μ
R76 15K
R77 1.5K
R79 82
R80 1.5K
R81 4.7K
C199 0.01μ
R82 10K
C200 0.01μ
C202 0.01μ
R83 100
2Vp.p Sine Wave Offset +12V
R84 10K
Q18
R87 390
TP4
C204 330P
Q19
C203 0.01μ
R85 15K
R86 1.5K
R88 82
R89 1.5K
R90 4.7K
C205 0.01μ
R91 10K
C206 0.01μ
C207 0.01μ
R92 100
+15V
TP5 ~ TP9
R93 10K
Q20
R96 390
TP5
C209 330P
Q21
C208 0.01μ
R94 15K
R95 1.5K
R97 82
R98 1.5K
R99 4.7K
C210 0.01μ
≈+12V
3V
230mVp.p/INPUT LEVEL -30dBm
270mVp.p/INPUT LEVEL -20dBm
310mVp.p/INPUT LEVEL -10dBm
350mVp.p/INPUT LEVEL 0dBm
+9V
C234 0.01μ
R141 820
+15V
TP10
R142 150
Q30
Q31
Q32
Q33
R144 150
R137 15K
R138 15K
C233 0.01μ
R139 2.2K
R140 51
R143 51
R145 2.2K
C238 0.01μ
R147 15K
R146 15K
C235 0.01μ
-15V
+15V
C236 0.01μ
R174 1K
C265 0.01μ
C237 0.01μ
R148 1K
R175 68
R149 51
R178 390
D46
R173 1K
R176 100
R150 50
Q37
Q34
Q38
+15V
TP11
To R151
L271
R171 1K
R177 12K
R172 33K
C267 0.01μ
R180 330
D45
※
C266 0.01μ
0395906-008-B
+15V
R101 100
C212 0.01μ
C217 0.01μ
R105 390
C214 330P
TP6
R102 10K
Q22
Q23
C213 0.01μ
R103 15K
R104 1.5K
R106 82
R107 1.5K
R108 4.7K
C215 0.01μ
R100 10K
C211 0.01μ
C218 0.01μ
R110 100
R114 390
C220 330P
TP7
R111 10K
Q24
Q25
C219 0.01μ
R112 15K
R113 1.5K
R115 82
R116 1.5K
R117 4.7K
C221 0.01μ
R109 10K
C216 0.01μ
C223 0.01μ
R119 100
R123 390
C225 330P
TP8
R120 10K
Q26
Q27
C224 0.01μ
R121 15K
R122 1.5K
R124 82
R125 1.5K
R126 4.7K
C226 0.01μ
R118 10K
C222 0.01μ
C228 0.01μ
R128 100
C231 0.01μ
R132 390
TP9
R129 10K
Q28
Q29
C229 0.01μ
R130 15K
R131 1.5K
R133 82
R134 1.5K
R135 4.7K
C230 0.01μ
R127 10K
C227 0.01μ
R136 10K
C232 0.01μ
LOG
0V
440mVp.p/INPUT LEVEL -30dBm
520mVp.p/INPUT LEVEL -20dBm
600mVp.p/INPUT LEVEL -10dBm
680mVp.p/INPUT LEVEL 0dBm
LIN or Q.P.
0V
560mVp.p/INPUT LEVEL -40dBm
180mVp.p/INPUT LEVEL -50dBm
56mVp.p/INPUT LEVEL -10dBm

Figure 7.22
LOG AMP CIRCUIT SECTION I

TP 14

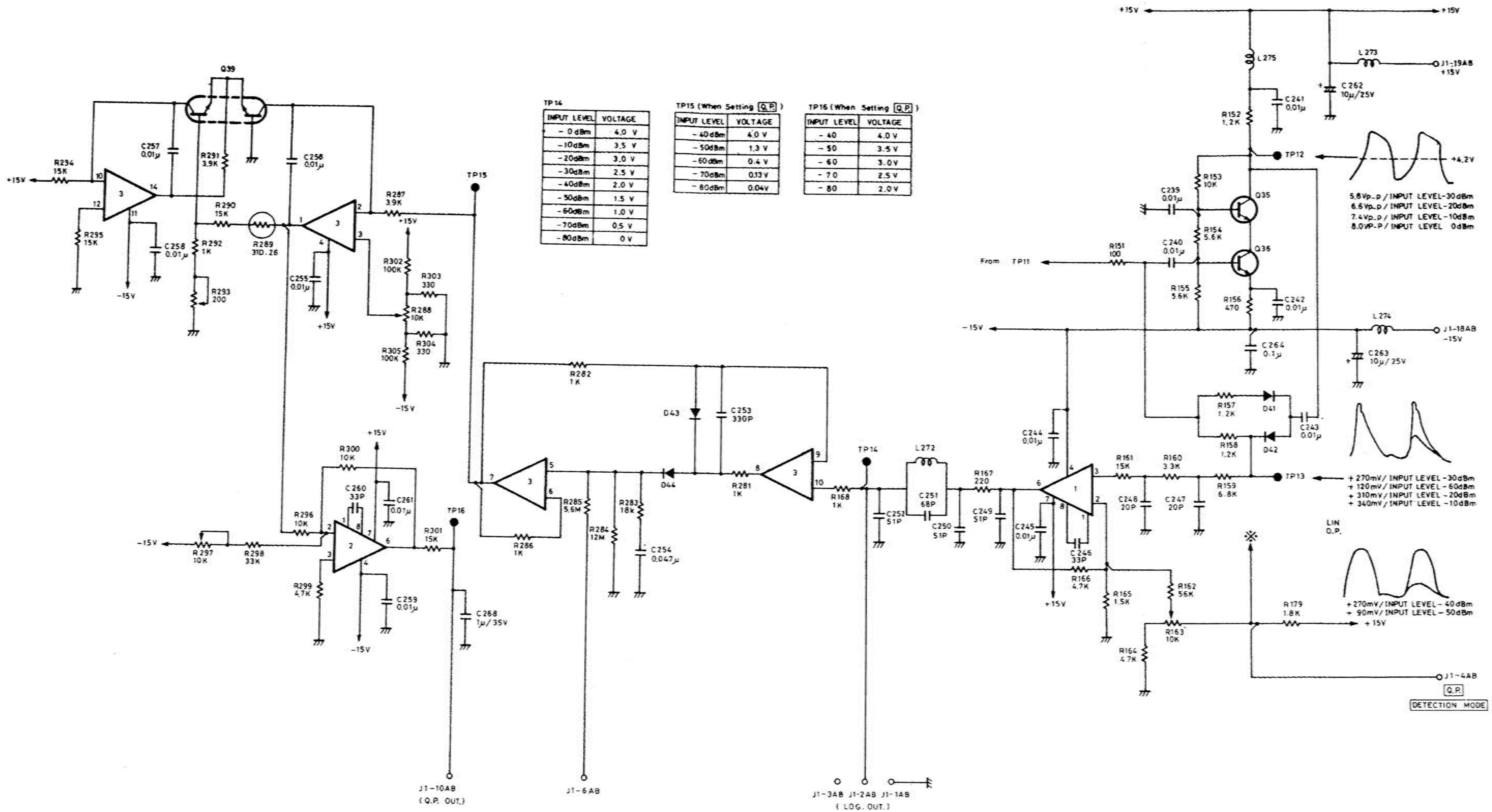
INPUT LEVEL	VOLTAGE
– 0 dBm	4.0 V
–10dBm	3.5 V
–20dBm	3.0 V
–30dBm	2.5 V
–40dBm	2.0 V
–50dBm	1.5 V
–60dBm	1.0 V
–70dBm	0.5 V
–80dBm	0 V

TP15 (When Setting [Q.P.])

INPUT LEVEL	VOLTAGE
–40dBm	4.0 V
–50dBm	1.3 V
–60dBm	0.4 V
–70dBm	0.13 V
–80dBm	0.04V

TP16 (When Setting [Q.P.])

INPUT LEVEL	VOLTAGE
– 40	4.0 V
– 50	3.5 V
– 60	3.0 V
– 70	2.5 V
– 80	2.0 V


Q39
R294 15K
+15V
R295 15K
C257 0.01μ
R291 3.9K
C256 0.01μ
R290 15K
R289 31D.26
C258 0.01μ
R292 1K
R293 200
-15V
C255 0.01μ
+15V
R287 3.9K
TP15
R302 100K
R303 330
R288 10K
R304 330
R305 100K
-15V
R282 1K
D43
C253 330P
D44
R281 1K
R285 5.6M
R283 18K
R284 12M
C254 0.047μ
R286 1K
R300 10K
+15V
C260 33P
C261 0.01μ
R296 10K
R297 10K
R298 33K
R299 4.7K
C259 0.01μ
R301 15K
TP16
C268 1μ/35V
-15V
J1-10AB (Q.P. OUT.)
J1-6AB
TP14
L272
R168 1K
C252 51P
C251 68P
C250 51P
R167 220
C249 51P
J1-3AB J1-2AB J1-1AB (LOG. OUT.)
+15V
L275
L273
J1-19AB +15V
C262 10μ/25V
C241 0.01μ
R152 1.2K
TP12
+4.2V
5.6Vp-p / INPUT LEVEL-30dBm
6.6Vp-p / INPUT LEVEL-20dBm
7.4Vp-p / INPUT LEVEL-10dBm
8.0VP-P / INPUT LEVEL 0dBm
R153 10K
C239 0.01μ
Q35
R154 5.6K
From TP11
R151 100
C240 0.01μ
Q36
R155 5.6K
R156 470
C242 0.01μ
-15V
L274
J1-18AB -15V
C264 0.1μ
C263 10μ/25V
R157 1.2K
D41
C243 0.01μ
R158 1.2K
D42
C244 0.01μ
R161 15K
R160 3.3K
R159 6.8K
TP13
+270mV/ INPUT LEVEL -30dBm
+120mV/ INPUT LEVEL -60dBm
+310mV/ INPUT LEVEL -20dBm
+340mV/ INPUT LEVEL -10dBm
C248 20P
C247 20P
C245 0.01μ
C246 33P
R166 4.7K
+15V
R165 1.5K
R162 56K
R163 10K
R164 4.7K
LIN O.P.
R179 1.8K
+15V
+270mV/INPUT LEVEL - 40dBm
+ 90mV/INPUT LEVEL - 50dBm
J1-4AB
Q.P.
DETECTION MODE

0395906-009- B

Figure 7.23
LOG AMP CIRCUIT SECTION II

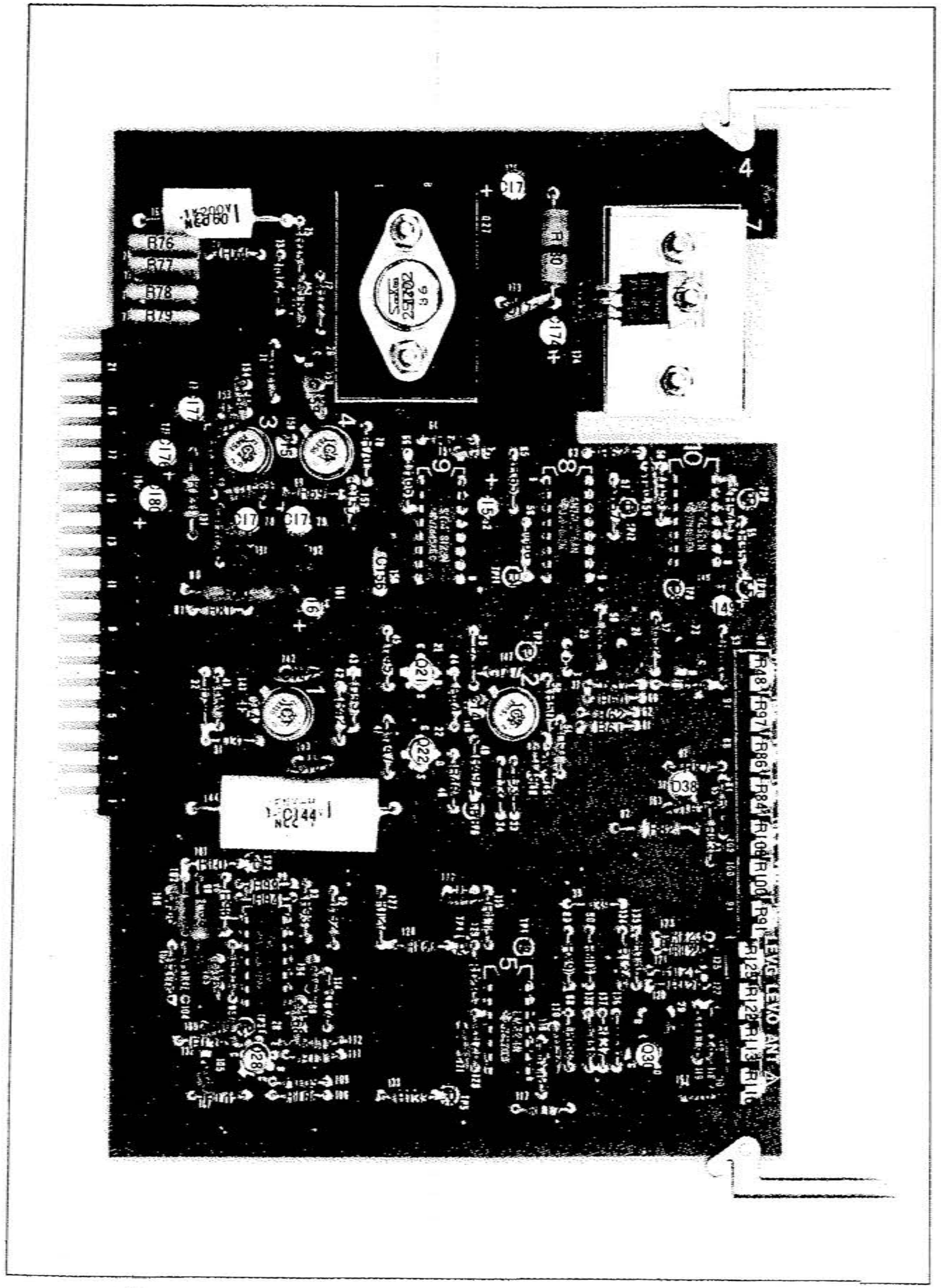
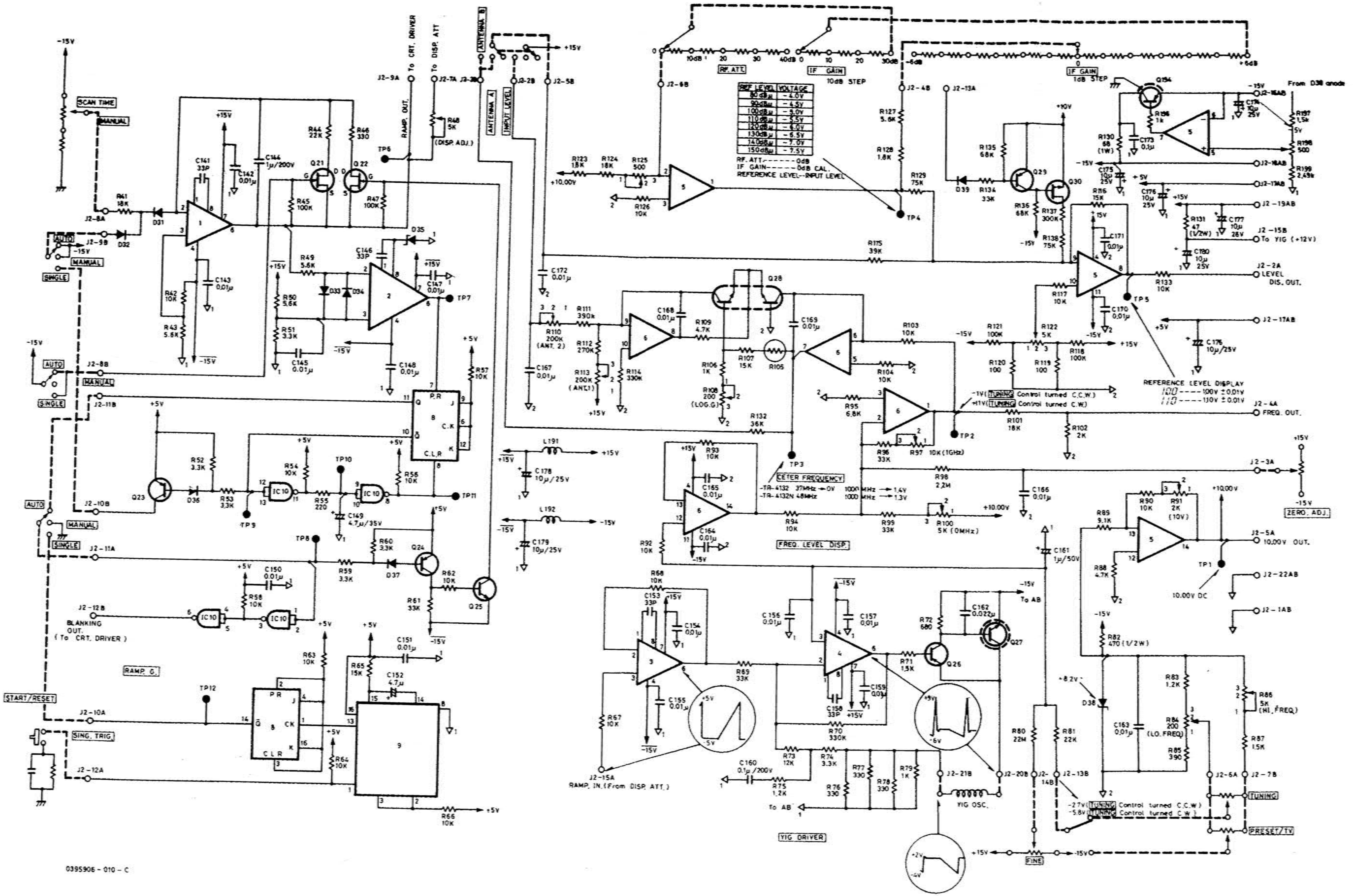

4
7
R76
R77
R78
R79
3
4
10
8
9
1
2
5
D38
D30
C144

Figure 7.24 RAMP GENERATOR & YIG DRIVER Bd LAYOUT (PF130)



REF LEVEL	VOLTAGE
80dBμ	-4.0V
90dBμ	-4.5V
100dBμ	-5.0V
110dBμ	-5.5V
120dBμ	-6.0V
130dBμ	-6.5V
140dBμ	-7.0V
150dBμ	-7.5V

RF. ATT--------0dB
IF GAIN--------0dB CAL.
REFERENCE LEVEL--INPUT LEVEL

-15V
SCAN TIME
MANUAL
AUTO
SINGLE
J2-8A
J2-9B
R41 18K
D31
D32
R42 10K
R43 5.6K
C141 33P
C142 0.01μ
C143 0.01μ
C144 1μ/200V
+15V
-15V
R44 22K
R46 330
Q21
Q22
R45 100K
R47 100K
R48 5K
(DISP. ADJ.)
TP6
RAMP. OUT.
To CRT. DRIVER
To DISP. ATT
J2-9A
J2-7A
J2-3B
J2-2B
J2-5B
ANTENNA B
ANTENNA A
INPUT LEVEL
+15V
D35
R49 5.6K
C146 33P
C147 0.01μ
D33
D34
R50 5.6K
R51 3.3K
C145 0.01μ
TP7
C148 0.01μ
+5V
R57 10K
J2-8B
J2-11B
P.R
Q
J
C.K
K
C.L.R
R52 3.3K
Q23
D36
R53 3.3K
R54 10K
R55 220
TP10
IC10
R56 10K
TP11
TP9
C149 4.7μ/35V
J2-10B
TP8
R60 3.3K
Q24
D37
R59 3.3K
J2-11A
R62 10K
R61 33K
Q25
C150 0.01μ
R58 10K
J2-12B
BLANKING OUT. (To CRT. DRIVER)
RAMP. G.
TP12
START/RESET
J2-10A
SING. TRIG.
J2-12A
R63 10K
R65 15K
C151 0.01μ
C152 4.7μ
R64 10K
R66 10K
0395906-010-C
L191
L192
C178 10μ/25V
C179 10μ/25V
0
10dB
20
30
40dB
RF. ATT.
IF GAIN
10dB STEP
30dB
-6dB
+6dB
IF GAIN
1dB STEP
J2-6B
R123 1.8K
R124 18K
R125 500
R126 10K
+10.00V
TP4
C172 0.01μ
R110 200K (ANT. 2)
R111 390k
R112 270K
R113 200K (ANT.1)
R114 330K
C167 0.01μ
C168 0.01μ
R109 4.7K
Q28
C169 0.01μ
R106 1K
R107 15K
R105
R108 200 (LOG.G)
R132 36K
TP3
CETER FREQUENCY
-TR-4132 37MHz→0V
-TR-4132N 48MHz
1000MHz→1.4V
1000MHz→1.3V
J2-4B
J2-13A
R127 5.6K
R128 1.8K
R129 75K
D39
R134 33K
Q29
Q30
R135 68K
R136 68K
R137 300K
R138 75K
+10V
R115 39K
R103 10K
R104 10K
R95 6.8K
R96 33K
R97 10K (1GHz)
TP2
R93 10K
C165 0.01μ
C164 0.01μ
R94 10K
R92 10K
FREQ. LEVEL DISP.
R98 2.2M
C166 0.01μ
R99 33K
R100 5K (0MHz)
+10.00V
Q154
R196 1k
From D38 anode
J2-16AB
C174 10μ 25V
R197 1.5k
R198 500
R199 2.49k
R130 68 (1W)
C173 0.1μ
J2-18AB
J2-17AB
J2-19AB
C175 10μ 25V
C176 10μ 25V
R116 15K
C171 0.01μ
R131 47 (1/2W)
C177 10μ 25V
C180 10μ 25V
J2-15B To YIG (+12V)
J2-2A LEVEL DIS. OUT.
R133 10K
TP5
R117 10K
C170 0.01μ
R121 100K
R122 5K
R118 100K
R120 100
R119 100
C176 10μ/25V
REFERENCE LEVEL DISPLAY
100----100V ±0.01V
110----110V ±0.01V
-1V(TUNING Control turned C.C.W.)
+1V(TUNING Control turned C.W.)
R101 18K
R102 2K
J2-4A FREQ. OUT.
J2-3A
ZERO. ADJ.
R90 10K
R91 2K (10V)
R89 9.1K
R88 4.7K
J2-5A 10.00V OUT.
TP1
10.00V DC
J2-22AB
J2-1AB
C161 1μ/50V
R68 10K
C153 33P
C154 0.01μ
C155 0.01μ
R67 10K
J2-15A RAMP. IN. (From DISP. ATT.)
R69 33K
C156 0.01μ
C157 0.01μ
C158 33P
C159 0.01μ
R70 330K
C162 0.022μ
R72 680
R71 1.5K
Q26
Q27
To AB
+5V
-5V
-6V
C160 0.1μ/200V
R73 12K
R74 3.3K
R75 1.2K
R76 330
R77 330
R78 330
R79 1K
J2-21B
J2-20B
YIG OSC.
YIG DRIVER
+2V
-4V
R82 470 (1/2W)
+8.2V
D38
R80 22M
R81 22K
J2-14B
J2-13B
C163 0.01μ
R83 1.2K
R84 200 (LO. FREQ)
R85 390
R86 5K (HI. FREQ)
R87 1.5K
J2-6A
J2-7B
TUNING
PRESET/TV
-2.7V(TUNING Control turned C.C.W.)
-5.8V(TUNING Control turned C.W.)
+15V
-15V
FINE

Figure 7.25
RAMP GENERATOR & YIG DRIVER CIRCUIT

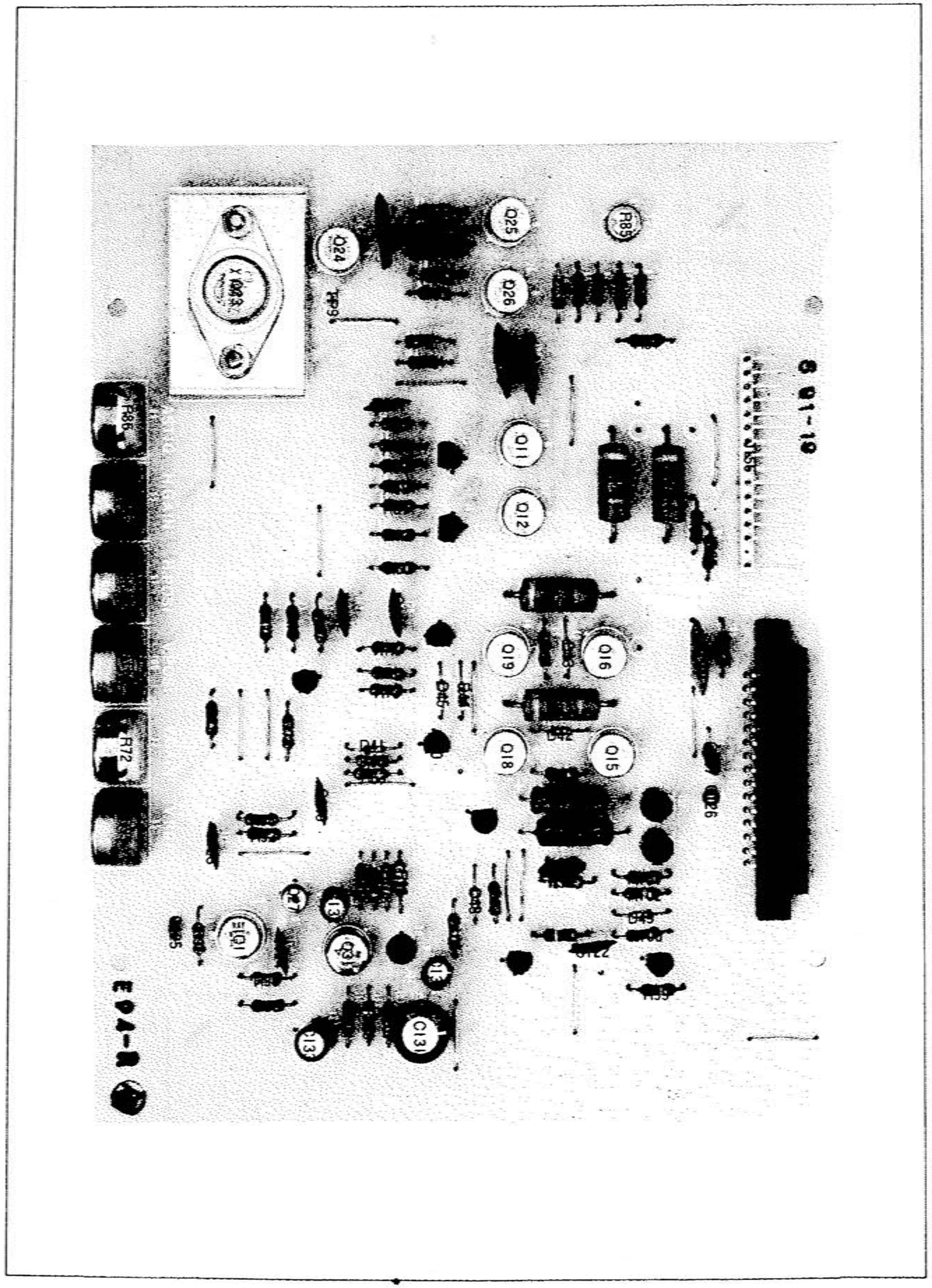
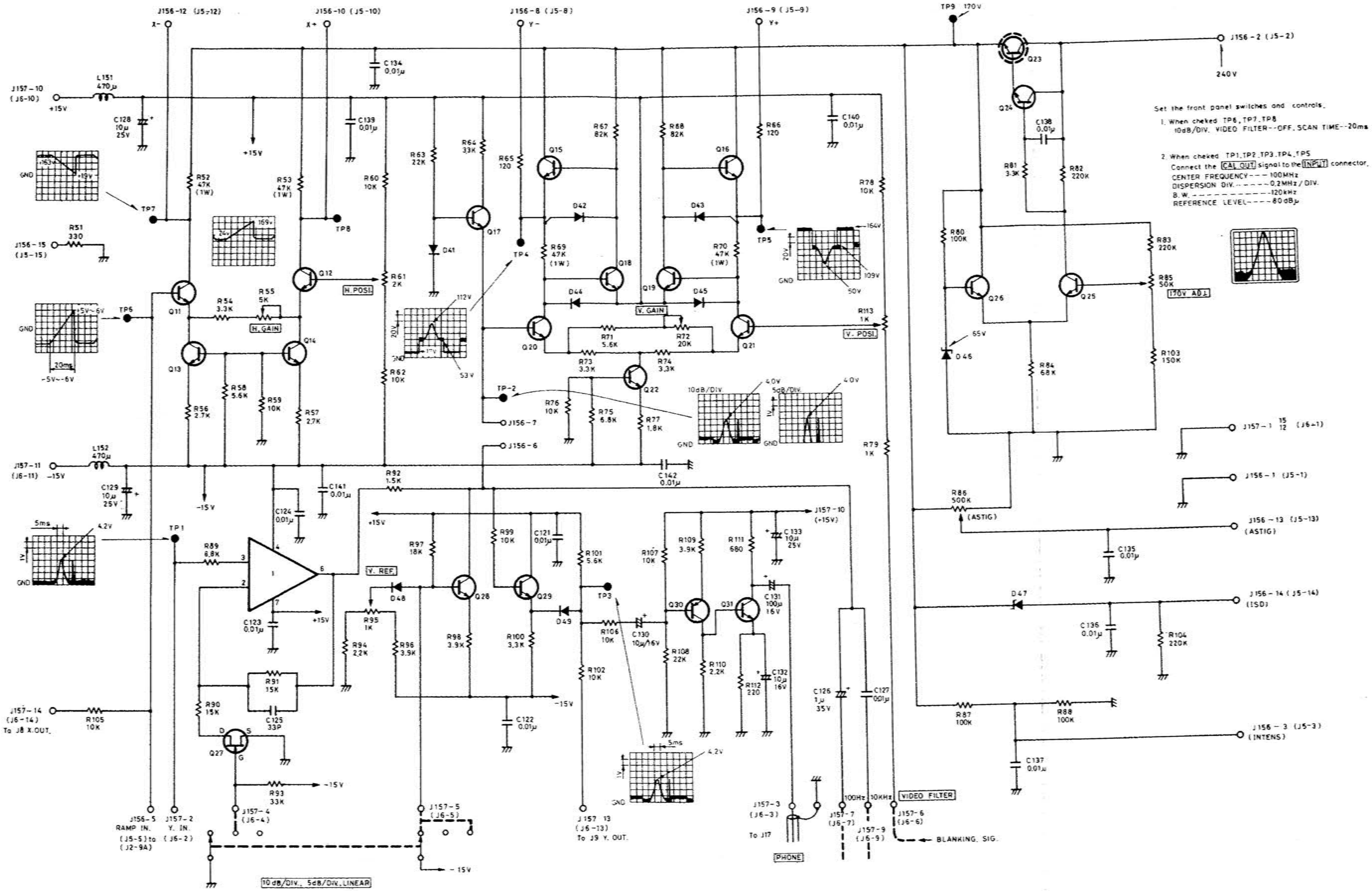

Q24
Q25
Q26
R85
R86
Q11
Q12
Q19
Q16
Q18
Q15
R72
C131

Figure 7.26 CRT DRIVER Bd LAYOUT (SG210)


J156-12 (J5-12)
X-
J156-10 (J5-10)
X+
J156-8 (J5-8)
Y-
J156-9 (J5-9)
Y+
TP9 170V
J156-2 (J5-2)
240V
J157-10
(J6-10)
+15V
L151
470μ
C128
10μ
25V
C134
0.01μ
C139
0.01μ
C140
0.01μ
+15V
R52
47K
(1W)
R53
47K
(1W)
R60
10K
R63
22K
R64
33K
R65
120
R67
82K
R68
82K
R66
120
R78
10K
Q15
Q16
Q17
Q23
Q24
C138
0.01μ
R81
3.3K
R82
220K
GND
+163V
+19V
TP7
TP8
24V
169V
R51
330
J156-15
(J5-15)
D41
D42
D43
TP4
TP5
R69
47K
(1W)
R70
47K
(1W)
Q18
Q19
164V
109V
50V
20V
R80
100K
R83
220K
R85
50K
170V ADJ
Q11
Q12
H. POSI.
R61
2K
112V
Q13
Q14
TP6
+5V~6V
-5V~-6V
20ms
R54
3.3K
R55
5K
H. GAIN
Q26
Q25
D44
D45
V. GAIN
Q20
Q21
R71
5.6K
R72
20K
R113
1K
V. POSI.
R73
3.3K
R74
3.3K
Q22
65V
D46
R84
68K
R103
150K
R58
5.6K
R59
10K
R56
2.7K
R57
2.7K
R62
10K
53V
17V
TP-2
J156-7
R76
10K
R75
6.8K
R77
1.8K
10dB/DIV.
5dB/DIV.
4.0V
J156-6
R79
1K
J157-1
15
12
(J6-1)
J157-11
(J6-11)
-15V
L152
470μ
C129
10μ
25V
C141
0.01μ
C142
0.01μ
-15V
R92
1.5K
J156-1 (J5-1)
R86
500K
(ASTIG)
J156-13 (J5-13)
(ASTIG)
5ms
4.2V
TP1
C124
0.01μ
+15V
J157-10
(+15V)
R89
6.8K
R97
18K
R99
10K
C121
0.01μ
R101
5.6K
R107
10K
R109
3.9K
R111
680
C133
10μ
25V
C135
0.01μ
1V
V. REF.
D48
Q28
Q29
TP3
C131
100μ
16V
D47
J156-14 (J5-14)
(ISD)
C123
0.01μ
+15V
R95
1K
D49
R106
10K
C130
10μ/16V
Q30
Q31
C136
0.01μ
R104
220K
R94
2.2K
R96
3.9K
R98
3.9K
R100
3.3K
R108
22K
R110
2.2K
R112
220
C132
10μ
16V
R91
15K
R102
10K
-15V
C126
1μ
35V
C127
0.01μ
R87
100K
R88
100K
J157-14
(J6-14)
To J8 X.OUT.
R105
10K
R90
15K
C125
33P
C122
0.01μ
J156-3 (J5-3)
(INTENS)
Q27
D
S
G
R93
33K
-15V
C137
0.01μ
J157-4
(J6-4)
J157-5
(J6-5)
J157-3
(J6-3)
To J17
100Hz
10KHz
VIDEO FILTER
J157-6
(J6-6)
J157-7
(J6-7)
J157-9
(J6-9)
J156-5
RAMP IN.
(J5-5) to
(J2-9A)
J157-2
Y. IN.
(J6-2)
J157 13
(J6-13)
To J9 Y. OUT.
PHONE
BLANKING. SIG.
-15V
10dB/DIV., 5dB/DIV., LINEAR

Set the front panel switches and controls.

1. When cheked TP6, TP7, TP8
   10dB/DIV. VIDEO FILTER--OFF. SCAN TIME--20ms

2. When cheked TP1, TP2, TP3, TP4, TP5
   Connect the CAL OUT signal to the INPUT connector.
   CENTER FREQUENCY---100MHz
   DISPERSION DIV.------0.2MHz / DIV.
   B. W.---------------120kHz
   REFERENCE LEVEL-----80dBμ

0395906 - 011 - C

Figure 7.27
CRT DRIVER CIRCUIT

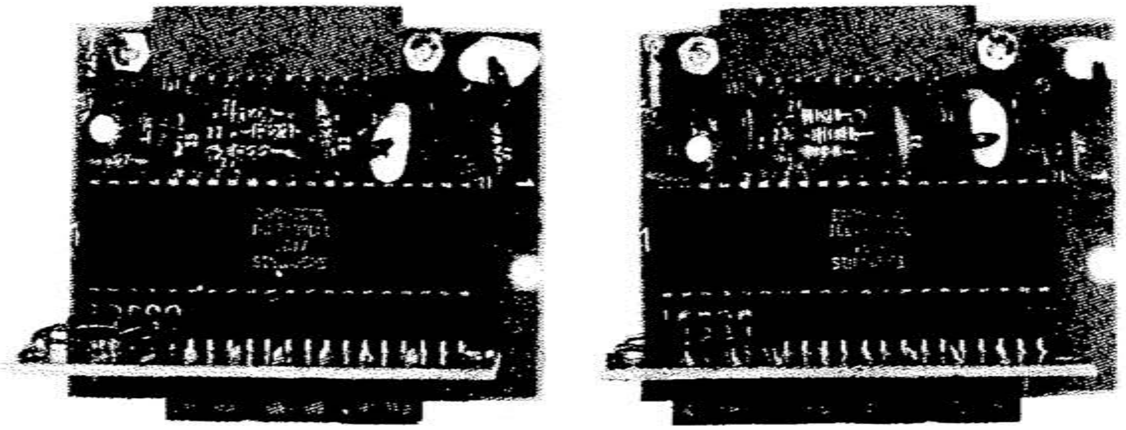
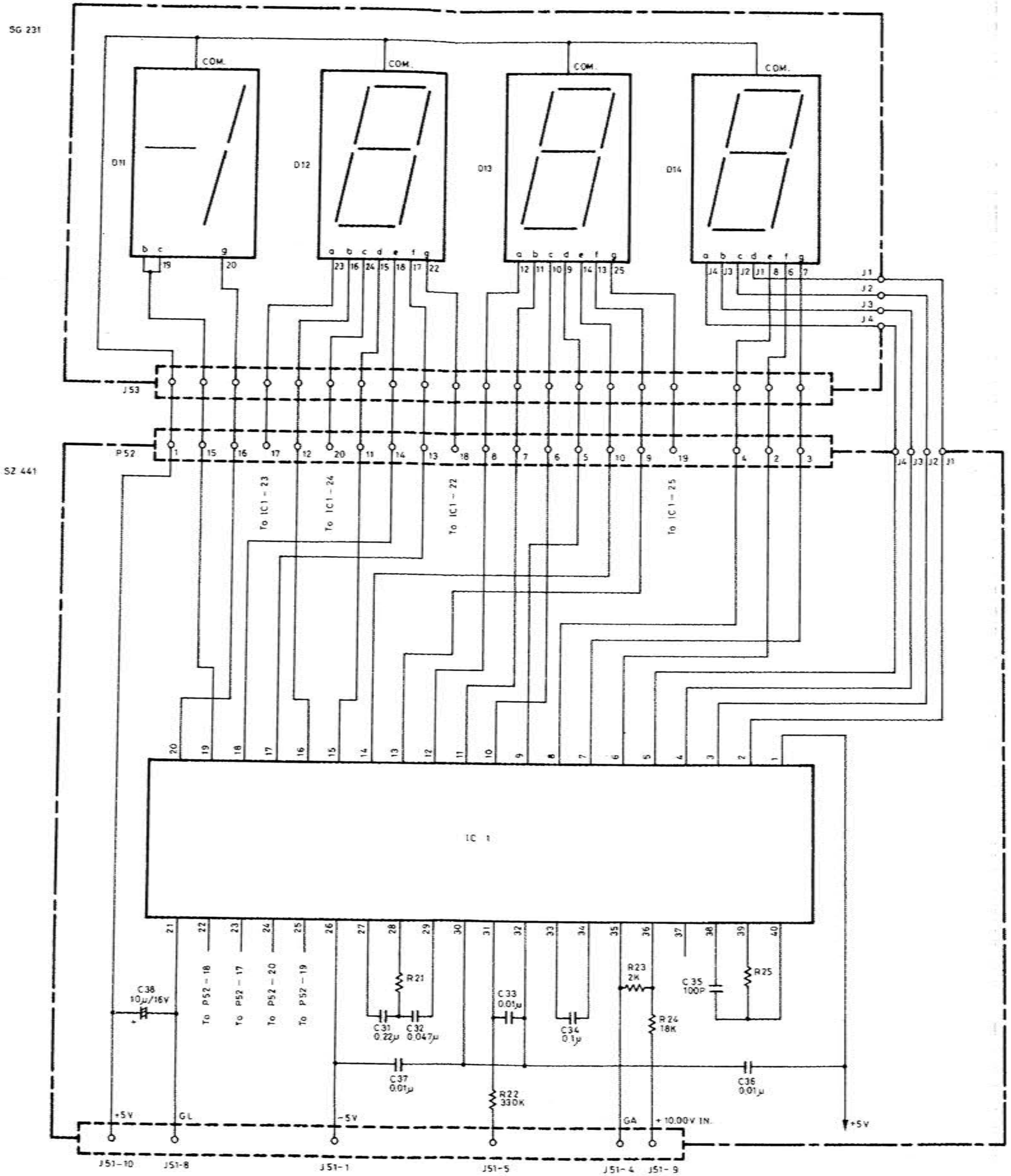


Figure 7.28 DPM ASSEMBLY (SG231, SZ441)

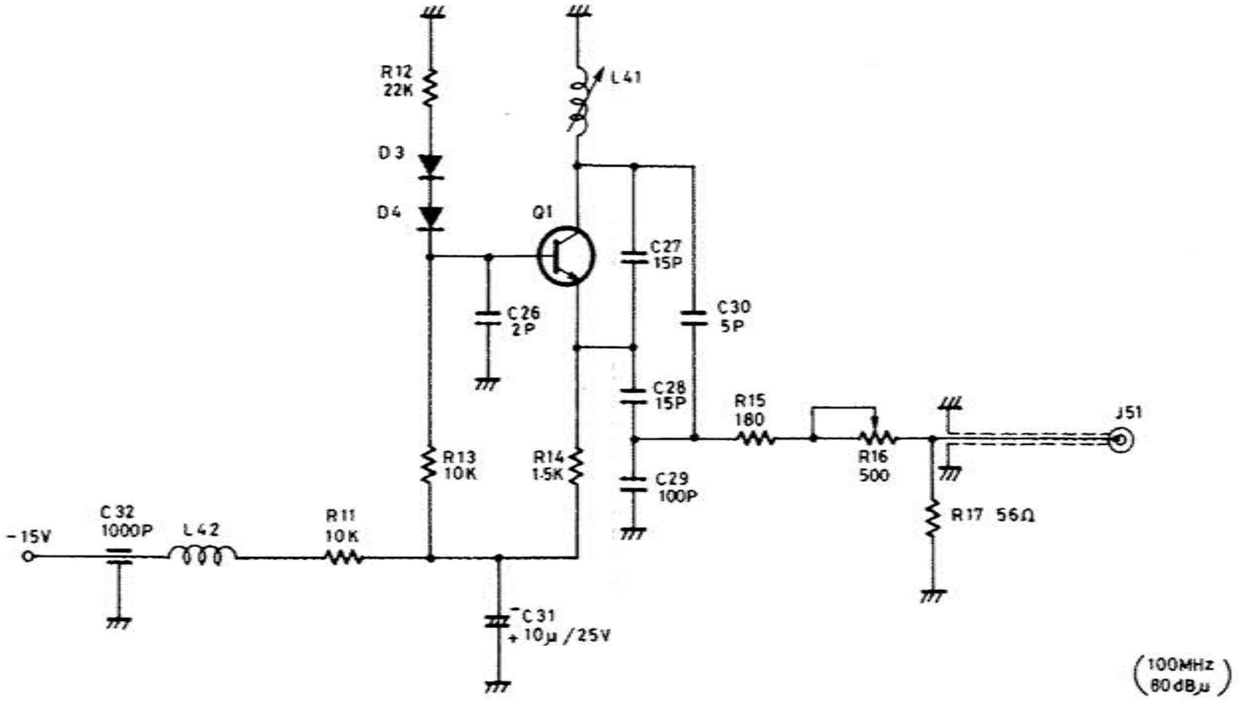

SG 231
SZ 441
COM.
D11
D12
D13
D14
a b c d e f g
J 53
P 52
J1
J2
J3
J4
To IC1 – 23
To IC1 – 24
To IC1 – 22
To IC1 – 25
IC 1
To P52 – 18
To P52 – 17
To P52 – 20
To P52 – 19
C38 10µ/16V
R21
C31 0.22µ
C32 0.047µ
C33 0.01µ
C34 0.1µ
C37 0.01µ
R22 330K
R23 2K
R24 18K
C35 100P
R25
C36 0.01µ
+5V
GL
–5V
GA
+10.00V IN.
+5V
J51-10
J51-8
J51-1
J51-5
J51-4
J51-9

	FREQUENCY DISPLAY
D14	mounted
R21	100kΩ
R25	22kΩ

0395906 – 012 – B

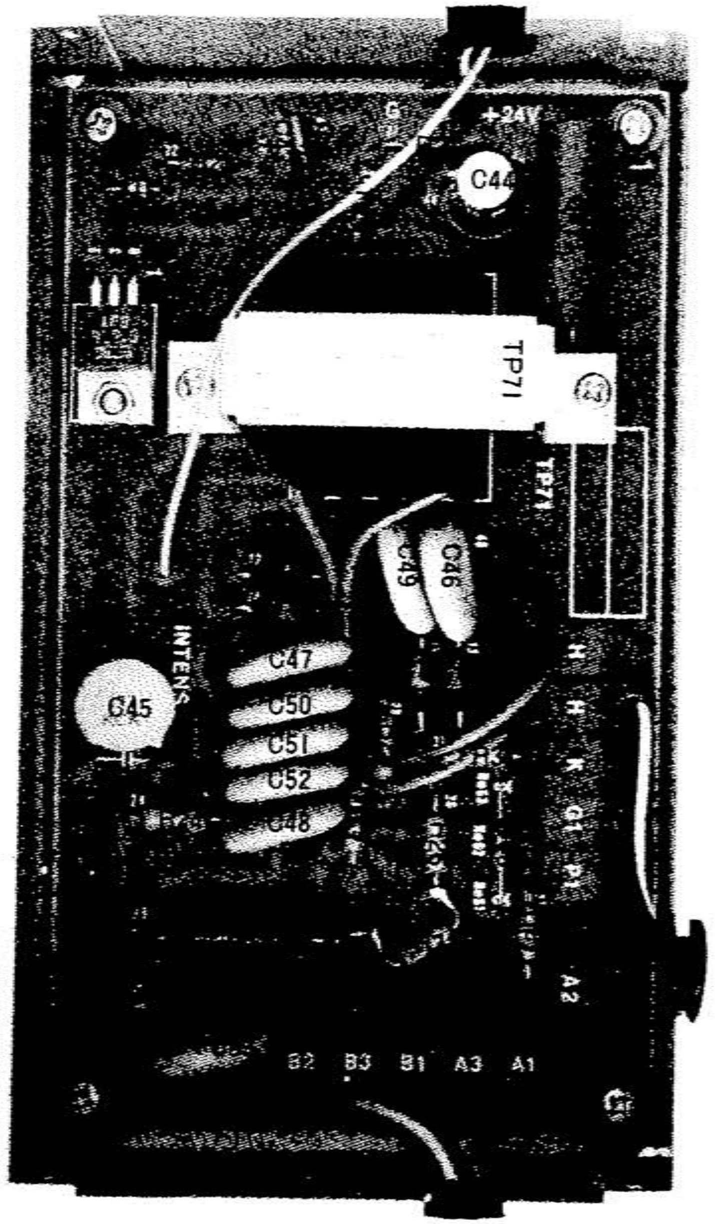
Figure 7.29
DPM CIRCUIT

Figure 7.30 CAL OSCILLATOR ASSEMBLY (SF145)


R12
22K
D3
D4
Q1
L41
C27
15P
C26
2P
C30
5P
C28
15P
R15
180
R16
500
J51
R13
10K
R14
1.5K
C29
100P
R17 56Ω
-15V
C32
1000P
L42
R11
10K
C31
10μ/25V
(100MHz
80dBμ)

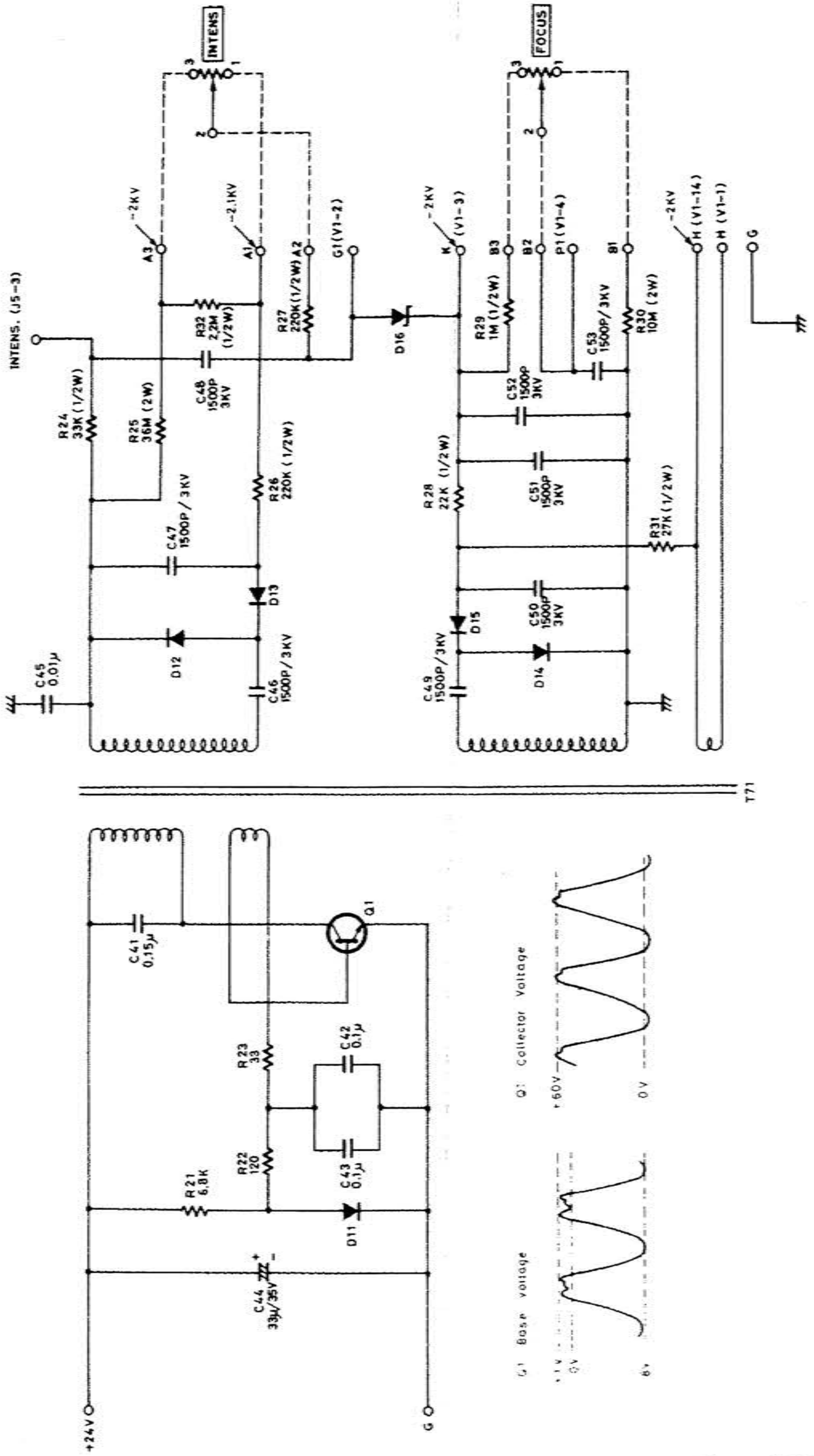
0395906-013 – B

Figure 7.31
CAL OSCILLATOR CIRCUIT



G
+24V
C44
TP71
TP71
C49
C46
INTENS
C45
C47
C50
C51
C52
C48
H
H
K
G1
P1
A2
B2
B3
B1
A3
A1

Figure 7.32 HIGH VOLTAGE POWER SUPPLY ASSEMBLY (MEP265)



INTENS
FOCUS
INTENS. (J5-3)
-2KV
A3
-2.1KV
A1
A2
G1 (V1-2)
K (V1-3)
B3
B2
P1 (V1-4)
B1
H (V1-14)
H (V1-1)
G
R24 33K (1/2W)
R25 36M (2W)
C48 1500P 3KV
R32 22M (1/2W)
R27 220K (1/2W)
R26 220K (1/2W)
C47 1500P/3KV
D12
D13
C45 0.01μ
C46 1500P/3KV
D16
R29 1M (1/2W)
C52 1500P 3KV
C53 1500P/3KV
R30 10M (2W)
R28 22K (1/2W)
C51 1500P 3KV
R31 27K (1/2W)
C50 1500P 3KV
D15
D14
C49 1500P/3KV
T71
C41 0.15μ
Q1
R23 33
C42 0.1μ
R22 120
C43 0.1μ
R21 6.8K
D11
C44 33μ/35V
+24V
G
Q1 Collector Voltage
+60V
0V
Q1 Base Voltage

Figure 7.33
HIGH VOLTAGE POWER SUPPLY CIRCUIT

ELECTRO-METRICS
A PENRIL CORPORATION®

100 Church Street • Amsterdam, New York 12010-4299
TEL: 518-843-2600 • TWX:710-446-4798 • 518-843-2812

CERTIFICATE NO. 2445

ELECTRO-METRICS

CERTIFICATE OF CONFORMANCE

Model No. BIA-25 ANTENNA
Serial No. 1061
Customer CONTEL STANFORD CT
P.O. # M230420

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology and conforms to MIL-Std-45662A. Calibration has been accomplished on the above-named instrument by comparison with standards maintained by ELECTRO-METRICS, or by an authorized facility. The accuracy and stability of all standards used are traceable to national standards maintained by the National Institute of Standards & Technology, Boulder, Colorado.

Temperature : 22 Degrees Centigrade
Humidity : 52 %

Standards Used :

FREQUENCY	WWV HF Transmission 15 MHz	NIST	N/A
A.C./D.C.	893A Differential Voltmeter	83286	B#2298
RF AMPLITUDE	Model 9200A RF Millivoltmeter	RO14405	B#2525
RESISTANCE	Leeds & Northrup Wheatstone Brdg.	37706	B#1567
ATTENUATION	JFW 50R-079 Attenuator	8201	B#0405

DATE : 12-19-91

Certified by:

Edward Raczes
Quality Control Manager

SERIAL
NUMBER
1061

ELECTRO-METRICS
GAIN AND ANTENNA FACTORS
MODEL BIA-25

1
METER
CALIBRATION

FREQUENCY MHZ	ANTENNA FACTOR DB	GAIN dBi	GAIN NUMERIC
20	18.0	-21.77	0.01
25	14.5	-16.30	0.02
30	11.8	-12.01	0.06
35	13.5	-12.34	0.06
40	14.0	-11.76	0.07
45	15.1	-11.75	0.07
50	14.0	-9.79	0.10
55	13.4	-8.38	0.15
60	11.8	-6.00	0.25
65	10.7	-4.15	0.38
70	9.0	-1.83	0.66
75	8.8	-1.03	0.79
80	9.6	-1.25	0.75
85	10.8	-1.98	0.63
90	12.1	-2.74	0.53
95	13.3	-3.50	0.45
100	14.0	-3.78	0.42
105	13.7	-3.07	0.49
110	14.9	-3.87	0.41
115	14.6	-3.17	0.48
120	14.8	-2.99	0.50
125	14.5	-2.31	0.59
130	14.2	-1.64	0.69
135	14.3	-1.48	0.71
140	14.5	-1.32	0.74
145	14.6	-1.17	0.76
150	15.3	-1.52	0.70
155	16.4	-2.38	0.58
160	16.6	-2.24	0.60
165	17.7	-3.10	0.49
170	18.8	-3.97	0.40
175	19.5	-4.35	0.37
180	20.1	-4.73	0.34
185	19.7	-4.11	0.39
190	19.8	-3.99	0.40
195	17.9	-1.88	0.65
200	18.5	-2.27	0.59

SPECIFICATION COMPLIANCE TESTING FACTOR (1 METER SPACING) TO BE ADDED TO RECEIVER METER READING IN dBuV TO CONVERT TO FIELD INTENSITY IN dBuV/METER. CALIBRATION PER ARP 958 METHODOLOGY.

SERIAL
NUMBER
1061

ELECTRO-METRICS
GAIN AND ANTENNA FACTORS
MODEL BIA-25

3
METER
CALIBRATION

FREQUENCY MHZ	ANTENNA FACTOR	GAIN dBi	GAIN NUMERIC
20	24.2	-27.97	0.00
25	17.8	-19.60	0.01
30	11.1	-11.36	0.07
35	13.3	-12.19	0.06
40	13.4	-11.16	0.08
45	11.9	-8.65	0.14
50	13.9	-9.69	0.11
55	12.3	-7.28	0.19
60	10.2	-4.45	0.36
65	9.1	-2.60	0.55
70	7.9	-0.78	0.84
75	5.7	2.02	1.59
80	6.9	1.35	1.36
85	8.2	0.61	1.15
90	9.4	-0.14	0.97
95	12.2	-2.40	0.58
100	12.4	-2.18	0.61
105	12.6	-1.97	0.64
110	13.3	-2.27	0.59
115	13.5	-2.07	0.62
120	12.7	-0.89	0.82
125	12.4	-0.21	0.95
130	11.5	0.96	1.25
135	11.7	1.12	1.30
140	11.9	1.28	1.34
145	12.5	0.93	1.24
150	13.2	0.58	1.14
155	14.3	-0.28	0.94
160	14.4	-0.14	0.97
165	16.1	-1.51	0.71
170	17.2	-2.38	0.58
175	17.8	-2.75	0.53
180	17.4	-2.13	0.61
185	11.2	4.34	2.72
190	12.3	3.46	2.22
195	10.4	5.57	3.61
200	11.1	5.18	3.30

SPECIFICATION COMPLIANCE TESTING FACTOR (3 METER SPACING) TO BE ADDED TO RECEIVER METER READING IN dBuV TO CONVERT TO FIELD INTENSITY IN dBuV/METER. CALIBRATION PER C.63.5 METHODOLOGY.

1 Meter Calibration.

GAIN AND ANTENNA FACTOR

BIA-25 Biconical Antenna

Serial No.1061

Frequency (MHz)	Gain	Antenna Factor* (dB)
20	.021	13.0
25	.059	10.5
30	.089	10.3
35	.073	12.5
40	.094	12.5
50	.148	12.5
60	.316	10.8
70	1.040	7.0
80	1.060	8.1
90	.752	10.6
100	.527	13.0
110	.461	14.4
120	.564	14.3
130	.769	13.7
140	1.043	13.0
150	1.117	13.3
160	.947	14.6
170	.799	15.8
180	.754	16.6
190	.563	18.3
200	.665	18.0

*Specification Compliance Testing Factor (1.0 meter spacing) to be added to receiver meter reading in dBuv to convert to field intensity in dBuv/meter.

GAIN AND ANTENNA FACTORS

ELECTRO-METRICS LPA-25 LOG-PERIODIC ANTENNA

Serial No. 1037

1 Meter Calibration

FREQUENCY (MHz)	NUMERICAL GAIN	ANTENNA FACTOR
200	2.104	13.0
250	2.344	14.5
300	2.507	15.8
350	3.282	16.0
400	3.343	17.0
450	3.761	17.6
500	3.319	19.0
550	4.097	18.9
600	3.983	19.8
650	4.315	20.2
700	3.691	21.5
750	4.438	21.3
800	4.219	22.1
850	4.482	22.3
900	3.993	23.3
950	5.010	22.8
1000	3.524	24.8

GAIN AND ANTENNA FACTORS

ELECTRO-METRICS LPA-25 LOG-PERIODIC ANTENNA

Serial No. 1037

3 Meter Calibration

FREQUENCY (MHz)	NUMERICAL GAIN	ANTENNA FACTOR
200	2.240	12.8
250	3.734	12.5
300	4.481	13.3
350	3.494	15.7
400	5.027	15.3
450	5.655	15.8
500	3.533	18.7
550	5.490	17.7
600	6.344	17.8
650	3.649	20.9
700	4.409	20.7
750	5.947	20.0
800	4.491	21.8
850	5.353	21.5
900	4.769	22.5
950	4.753	23.0
1000	5.003	23.3

3 Meter Calibration

GAIN AND ANTENNA FACTOR

BIA-25 Biconical Antenna

Serial No. 1061

Frequency (MHz)	Gain	Antenna Factor* (dB)
20	.005	19.3
25	.031	13.2
30	.095	10.0
35	.124	10.2
40	.142	10.8
50	.281	9.7
60	.378	10.0
70	1.107	6.7
80	1.128	7.8
90	.714	10.8
100	.793	11.3
110	1.098	10.7
120	1.198	11.0
130	1.634	10.4
140	1.245	12.2
150	.945	14.0
160	.450	17.8
170	.676	16.6
180	.638	17.3
190	1.197	15.0
200	1.413	14.8

*Specification Compliance Testing Factor (3.0 meter spacing) to be added to receiver meter reading in dBuv to convert to field intensity in dBuv/meter.